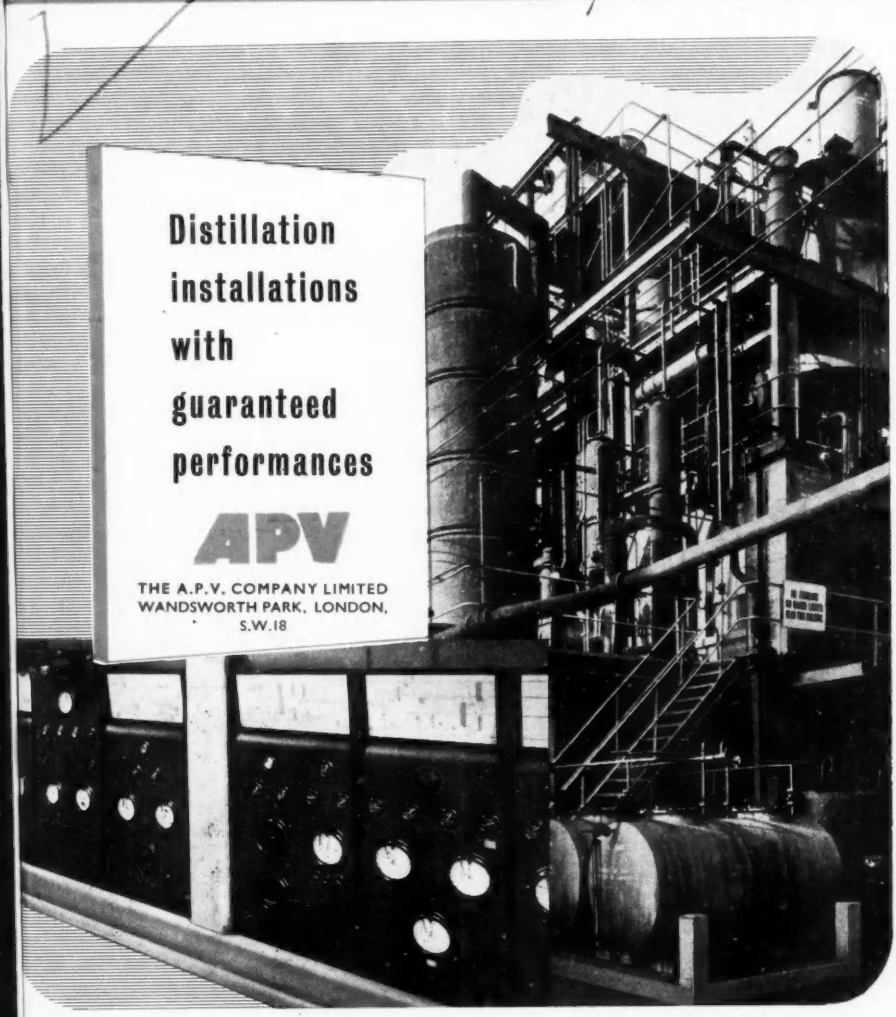
The Chemical Age

VOL LXIII 29 JULY 1950 NO 1620



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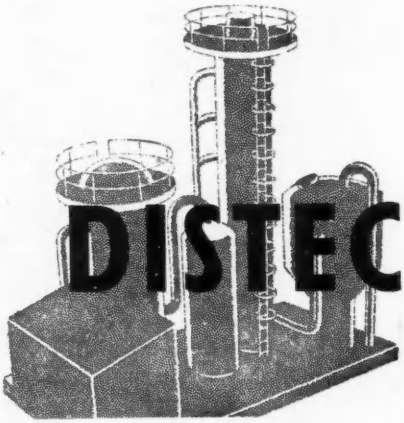

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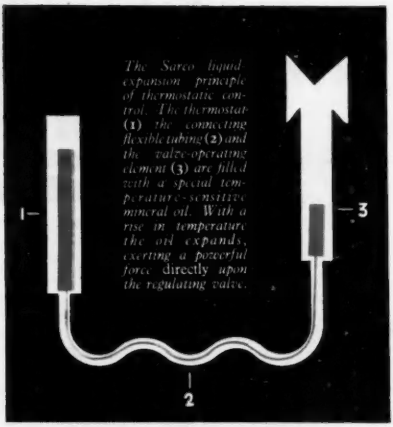

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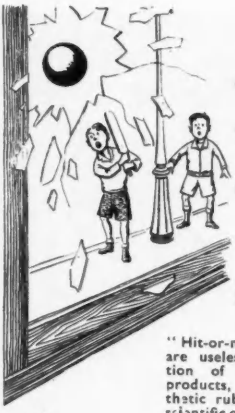

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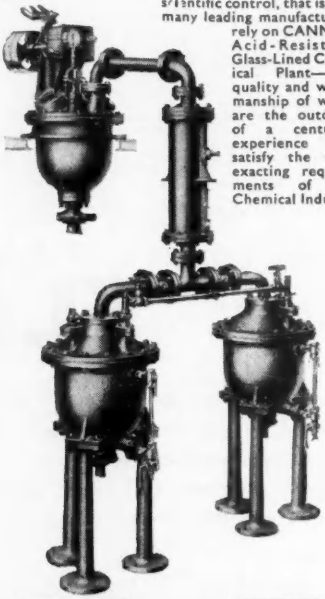

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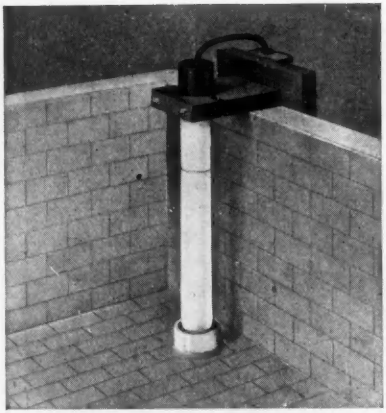

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The Chemical Age

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Volume LXIII 29 July 1950 Number 1620

Training the Technologists

THE extreme difficulties which hedge around any attempt to produce a national policy that will ensure a well balanced supply of science-trained people needed for industry, research and education derive fresh confirmation from the current summing up by the principal body of experts in this country. The findings are those of the Advisory Council on Scientific Policy, the group of very able figures in science and industry over which Sir Henry Tizard presides, and it is fair to assume that the shape of Government policy in regard to university grants, aid to corporate research and regulations for industry itself will be influenced very largely by what this advisory council has to say. There is therefore good reason to be thankful for the fact that this farseeing group is not overloaded either with academic interests or with those whose preoccupation with production might blind them to the continual need for the kind of work which might appear to have no immediate utility.

The Advisory Council on Scientific Policy can be assumed to enjoy as comprehensive a view as any group's of what will be needed to ensure the accelerating rate of advance in the sciences and of their application in the country's industries. But with all their expertness and privileged supply of information, the members of this council are as reluctant to lay down a rigid programme to govern the equipment of scientists for the country's future needs as any other informed body would be. The third report on "Scientific Policy" does not seek to disguise the facts that the supply of scientists and their allocation cannot be regulated even with the wavering precision of a commodity rationing scheme, and that industry's future need of scientists is not susceptible to exact measurement from the standpoint of to-day. That does not preclude the advisory council, however, from offering some extremely illuminating conclusions about the future.

Perhaps the most interesting conclusion is that university departments have, in general, expanded sufficiently to satisfy the prospective demand for qualified workers in several of the principal fields of science—physics, geology, civil, mechanical and electrical engineering, biology and agriculture. The satisfaction that can be taken in such news, as affording a cheerful contrast with the estimates by the Barlow Committee of a formidable shortfall, will be tempered by the reservation, which the report includes, that "continuing shortages are expected in the fields of chemistry

On Other Pages

The annual subscription to THE CHEMICAL AGE is 30s.; single copies, 9d.; post paid, 1s.: SCOTTISH OFFICE: 116 Hope Street, Glasgow (Central 3970). MIDLANDS OFFICE: Daimler House, Paradise Street, Birmingham (Midland 0784-5). THE CHEMICAL AGE offices are closed on Saturdays in accordance with the adoption of the five-day week by Benn Brothers, Limited.

and chemical engineering." One does not need to be a chemist to discern that those are the branches in which the call henceforth is likely to be the most imperative, and in which failure to supply what is required can have the most depressing influence on advances in methods and the scope of future production.

The advisory council must be well aware of that, as its comments on the need for ample supply and use of scientists indicate. Yet it has to be recalled that even the report upon the future supply of chemical engineers and probable requirements for their services which the Ministry of Labour's Technical Personal Committee was long ago expected to produce still appears to be in the preparatory stages. The advisory council has no comments to offer about that, but it has some very firm conclusions on the controversial subject of extending higher education in applied science, either within the universities or in specialist institutions.

Despite the knowledge that university chairs of chemical engineering are still rarities, the advisory council has not departed from the view that the universities should continue to be the prime centres for the more advanced training in the applied sciences. It is now squarely recognised, however, that the university faculties and the technical colleges are unlikely to supply unaided all that is needed, and that the proposed means of supplementing them cannot be called into being quickly enough to serve the needs of the moment. The advisory council's ruling is this:—

As soon as the resources, material and human, can be employed without detriment to the work in applied science which the universities are already doing, it would be prudent to establish one or more colleges of applied science, with suitable governing bodies of their own, but fitted into the university system. We would emphasise again that these colleges should be regarded as an addition, and not as an alternative, to the facilities already provided by university departments of applied science. The contribution of university departments of applied science, at both the under-graduate and post-graduate stages, to the immediate needs of industry is of great importance, for even if new institutes of higher technology are established, it cannot be expected that they will make an important contribution to higher technological education within much less than a decade."

Notes and Comments

High Level of Exports

THE latest record of British chemical exports during June has shown that the possibility of a recession in sales to the increasingly competitive overseas markets, of which chairmen of some chemical groups have given warning, has not yet become a reality. The record total sales of £8.428 million which the chemical categories ("chemicals, drugs, dyes and colours") achieved in June is evidence of this, and in surpassing by nearly £1.5 million the collective sales recorded 12 months before the export organisations have reaffirmed that scope still exists to restore in other markets the reductions which currency or political pressure have imposed elsewhere. Among the shipments which have collectively redressed so generously the several substantial cuts during June, most gratifying, perhaps, is the rise in chemical sales to the U.S.A., from £69,347 in the previous June to £255,949 last month, and the strong upward movement in most British countries overseas—Australia, New Zealand, Canada and Malaya (but not South Africa). The increasing difficulties of trade with India are again represented by a drop in sales by more than one-third by comparison of the June totals this year and last. Consolation can be taken from the further evidence that Pakistan's purchasing capacity seems to grow as India's wanes, and from the extremely high totals recorded for the principal sodium chemicals (carbonates £219,889 and caustic £281,540) against which virtual barriers have been raised in the Indian market.

Impersonal Festival

LONDONERS have been given visual reminders in the past few weeks that the Festival of Britain has emerged from the status of a project—admirable or frivolous, according to one's outlook—and is rapidly taking physical shape. No hasty conclusions should be drawn from the fact that the predominant outline on the Thames-side site at the moment is that of a mushroom, although it calls to mind the fact that one of the keystones of the South Bank attractions will be the Dome of Discovery, the centrepiece of a general panorama of British scientific and industrial enterprise, of which other wings will be at South Kensington and in Glasgow. The magnitude of the construction going on on the South Bank corresponds with the all-embracing character of the proposals to represent science and industry, calling for the expert services of some of the foremost people in science at the present time and the full collaboration of industries. The scientists will, as usual, remain in the background and, because the organisers are anxious that this shall not be confused with a trade exhibition, the same anonymity will be imposed on the industries—on whose achievements in the laboratory or the workshop most of the originality of the displays will depend.

No Names

A DISCONCERTING possibility is that this determination to avoid the "trade show" atmosphere will invest the picture of industry presented at the Festival of Britain with the tepid anonymity that characterises some BBC surveys when they are dominated by the same "no advertising" principle. To attempt to give a fair picture either of scientific discovery or of the application of discoveries without some recognition of the private organisations which have often carried out most of the tasks seems an absurdity. A great deal of Britain's scientific progress has sprung from private enterprise and must continue to do so. As it is, visitors to the Festival may be invited to believe that all discoveries here are made by university professors and that their applications depend largely upon government departments and committees, working parties, or even Royal Commissions.

If anonymity is to be rigidly preserved it is to be hoped it will apply as forcibly to nationalised undertakings as to private enterprises. Private enterprise and state monopoly must go to the Festival on equal terms if it is hoped to gain a full response to the "final invitation" which industries have received this week.

Education in Industry

TRAINING schemes to provide that young recruits are well equipped to serve the needs of industry are now fairly familiar. Much less often does one hear of equal thought being given to a complementary aspect of the same theme, the grooming of industries to ensure that the youngster receives the kind of reception and initiation which will help to make him or her happy and useful. That is the theme of a conference, the third to discuss "The Education of the Young Worker," to be held at Magdalen College, Oxford, on August 12 to 18. The Oxford University Department of Education, which is sponsoring it, believes that elaborate selection and technical training schemes, which were given careful thought last year and in 1948, do not alone discharge all the responsibilities which industries owe to the people who will help to form the industrial pattern in the future. The sponsors take a broad view of the amount of work which requires to be done on the subject of reception into industry. It does not end, as they remark, by ensuring that the reception officer has a pleasant smile and that there is a television set in the apprentices' common room. They sum up rather neatly one of the problems about which questions will be asked at Oxford in the hope that satisfactory answers will ultimately be framed: Who should teach them (the trainees) how to know nonsense when they hear it spoken?

LETTER TO THE EDITOR

NCB and Tar Research

Sir—May I refer to the editorial article in your issue of July 8, in which you state: "Wisely the NCB finances, and takes some part in directing, the work of some other associated research organisations. Among them is the Coal Tar Research Association, whose potential scope is discussed in this issue." This statement may perhaps convey the impression that the association's income is derived entirely from the National Coal Board, which is not in accord with the facts. The National Coal Board is one of the largest and most important members of CTRA, and the association has enjoyed the most wholehearted support from its representatives. However, it is only one of many members and, like all other members—area gas boards, tar distillers and independent coke-oven tar producers—contributes to the funds of the research association in proportion to the amount of tar which it produces and distills.

Yours, etc.—DONALD MCNEIL,
Director of Research.

The Coal Tar
Research Association,
Gomersal, near Leeds.

Fewer Dollars for Oil

A FURTHER agreement between the United Kingdom Government and an American-controlled oil company to reduce the dollar costs of oil imports to the sterling area was announced last week by the Ministry of Fuel.

The company, Caltex (U.K.), is a subsidiary of California Texas Oil, and under the deal it is proposed to reduce the "dollar content" of its oil supply to an average of about 30 per cent. At present supplies to the sterling area are about three million tons a year. It is estimated that when the scheme is fully effective in 1952, there will be a saving of $30-40 million annually.

The saving will be accomplished by a combination of three means: Using crude oil produced in Bahrein as sterling oil; making payments partly in sterling for crude oil purchased from the Arabian American Oil Company (Aramco) which is to switch a portion of its expenditure from dollars to sterling; and by converting, over a period, freight charges to a sterling basis.

The last proposal would necessitate building a number of tankers in the U.K. to transport oil from Bahrein to the sterling area.

EXPORTS AGAIN EXCEED £8m.

Sustained Improvement Since January

EXPORTS of chemicals, drugs, dyes and colours in June maintained the high level established in May with a total of £8,428,589 compared with £6,947,307 in June, 1949. Sodium compounds were all marked by large increases, the total value for the carbonates alone being £219,889 as against £79,756 in June last year.

The first six months of this year also showed the cumulative effect of the several rises in exports, the value of chemical manufactures being £25,512,417 compared with £23,428,555 in 1949, and £21,908,843 in 1948. Total of all chemicals, drugs, dyes and colours for the period was £47,101,387, an increase of £2,560,482 over the first half of 1949.

EXPORTS	June, 1950	June, 1949
Cresylic acid	Gal. 221,869	Gal. 83,565
Salicylic acid and salicylates	lb. 182,184	lb. 120,362
Value of all other sorts of acid	£155,377	£109,985
Sulphate of alumina	Tons 2,190	Tons 3,405
All other sorts of aluminium compounds	1,836	413
Ammonium sulphate	18,580	33,262
Ammonium nitrate	3,699	3,883
All other sorts of ammonium compounds	1,202	1,193
Bleaching powder	Cwt. 20,209	Cwt. 29,752
All other bleaching materials	12,472	9,711
Collodion cotton	2,202	3,343
Copper sulphate	Tons 2,727	Tons 4,988
Disinfectants, insecticides, etc.	Cwt. 46,393	Cwt. 52,361
Fertilisers	Tons 1,517	Tons 811
Value of gases (compressed, liquefied or solidified)	£22,926	£18,914
Lead acetate, litharge, red lead, etc.	Cwt. 12,038	Cwt. 4,774
Tetra-ethyl lead	Gal. 109,680	Gal. 86,586
Magnesium compounds	Tons 1,147	Tons 597
Nickel salts	Cwt. 2,519	Cwt. 3,672
Potassium compounds	7,549	4,751
Salt	Tons 22,470	Tons 15,321
Sodium carbonate	Cwt. 430,843	Cwt. 150,372
Caustic soda	224,805	157,998
Sodium silicate	34,593	17,045
Sodium sulphate	136,091	65,725
All other sodium compounds	83,030	59,592
Tar oil, creosote oil, anthracene oil, etc.	Gal. 2,443,167	Gal. 1,129,355
Zinc oxide	Tons 917	Tons 838
Total value of chemical manufacturers (excluding drugs and dyestuffs)	£4,425,050	£3,665,357
Value of quinine and quinine salts	£44,718	£34,405
Acetyl-salicylic acid	lb. 161,019	lb. 135,286
Insulin	100 International Units 808,832	100 International Units 943,679
Penicillin	Mega Units 1,298,565	Mega Units 683,863
Total value of drugs, medicines and preparations	£1,906,857	£1,676,732
Total value of dyes and dyestuffs	£941,804	£732,534
Total value of paints, pigments, colours, etc.	£1,154,878	£872,684
Total value of chemicals, drugs, dyes and colours	£8,428,589	£6,947,307
Plastic materials :		
Synthetic resins, solid and liquid, including adhesives	Cwt. 25,928	Cwt. 17,168
Moulding powders	18,791	9,130
Sheet, rod, tube, film and foil—		
Laminated	2,247	1,910
Non-laminated : acrylic	3,833	2,234
celluloid	1,268	773
other sorts	2,854	2,129
Total value	£716,144	£426,268
Chemical glassware	Cwt. 1,404	Cwt. 1,008
Value	£62,731	£44,575
Fans	Cwt. 5,663	Cwt. 3,342
Value	£139,942	£104,353
Furnace plant	Cwt. 10,019	Cwt. 6,834
Value	£133,603	£81,972
Gas and chemical machinery	Cwt. 16,796	Cwt. 18,950
Value	£252,991	£214,319
Scientific instruments : optical		
Value	£83,528	£78,318
Thermometers, mercury in glass, etc.—**Value**	£44,053	£36,868
Air and gas compressors and exhausters	Cwt. 14,373	Cwt. 13,684
Value	£308,377	£291,849
Non-Ferrous Metals :		
Aluminium and aluminium alloys	Cwt. 89,478	Cwt. 116,252
Value	£1,125,246	£1,316,552
Bismuth metal (not including alloys)	lb. 30,379	lb. 9,857
Value	£19,883	£5,286
Copper	Tons 5,531	Tons 8,951
Value	£1,163,718	£1,338,400
Lead, unwrought, sheet, etc	Tons 330	Tons 275
Value	£48,932	£43,300
Nickel and manufactures thereof	Cwt. 16,908	Cwt. 24,757
Value	£335,138	£347,958
Nickel alloys	Cwt. 7,784	Cwt. 7,237
Value	£167,238	£147,676
Tin, unwrought	Tons 1,647	Tons 271
Value	£991,795	£155,089
Tungsten (except ferro-tungsten)	lb. 10,709	lb. 16,503
Value	£8,992	£16,829
Zinc	Tons 367	Tons 429
Value	£66,153	£56,758
Total value of non-ferrous metal group	£5,784,999	£5,078,318

Parliamentary Topics

THE possibility that fire hazards in trains may be increased by application of lacquer finish to paintwork was the subject of a question by Sir R. Glyn. He asked if the Minister of Transport was aware that the report of the DSIR into the fire on a train last autumn near Berwick disclosed that the lacquer paintwork was 16.7 per cent nitro-cellulose and 75 per cent solvent; how far the conditions in the recent fatal fire on the Birmingham-Glasgow train were similar and what action was being taken.

Mr. A. Barnes said the report of the inspecting officer of railways (THE CHEMICAL AGE, 62, 430) indicated that the composition of the clear lacquer was substantially as stated. Coaches sprayed with this particular cellulose lacquer had been withdrawn immediately after the accident. Other coaches in which cellulose lacquers of any kind might have been used were being tested for fire risk as they passed through workshops for repair, and suitable preventive precautions were being taken. The whole question of the interior finishing of railway coaches in relation to fire risks was under review with the Railway Executive.

The fatal fire near Beattock on June 8 this year was still under review by an inspecting officer of railways, and he could therefore make no statement until a report had been received.

REOPENING of the London Metal Exchange to deal in copper was urged by Mr. W. Fletcher. Replying, Mr. G. R. Strauss, Minister of Supply recalled the previous statement on June 20 by Mr. John Freeman (Parliamentary Secretary) that it did not seem possible to free the market either until our dollar balance was a great deal more secure or until it was possible to satisfy a much higher proportion of our needs of electrolytic copper from Northern Rhodesia. Mr. G. R. Strauss said he was willing to consider any proposals which would overcome these difficulties.

OIL pollution from ships and refineries in Southampton harbour and the neighbourhood of the Isle of Wight was the subject of questions by Surgeon Lieut.-Commander Bennett. Mr. A. Barnes, Minister of Transport, stated that the Oil in Navigable Waters Act, 1922, gave him no power to take proceedings for an offence committed within a harbour. In further discussion of discharge of oil from the refinery at Fawley and tankers using it, the Minister said that if the question was put down he would endeavour to answer it.

POLLUTION of beaches from oil was also referred to by Mr. A. Barnes, who recalled that a voluntary agreement stipulated that oil should not be discharged from ships within 50 miles of any coast.

Fertiliser Subsidy

IN a broadcast on July 23 the Minister of Agriculture, Mr. Tom Williams, spoke of the new subsidy on fertilisers. Mr. Williams said: "The Bill providing for this subsidy has passed through Parliament, and when it becomes an Act I shall issue a scheme to put it into operation. I want to mention only two points now. First, I intend that the scheme will date back to July 1 this year—the day on which the prices for fertilisers went up. Fertilisers bought at the new prices and applied to grassland will qualify for the grant of one-third of what they cost, or if applied to ploughed up old grass of two-thirds of their cost—subject, of course, to the maxima laid down in the scheme.

"My second point is this: If you want to apply for the subsidy in due course, you should keep a careful record now of the amount actually applied to grassland or ploughed-up grassland and the fields to which it was applied."

Rubberised Roads Experiment

TESTS are being carried out at Dunlop's factory at Speke, Liverpool, of a new "rubber" road surface. Four stretches of roadway are under observation, two laid without rubber and two containing a small percentage of rubber. The rubber is in the form of a powder produced from natural latex and has been added to a fine asphalt surface mixture and to a medium texture tar surfacing mixture. The Dunlop organisation states that, in the laying, the rubber mix behaved in the same way as the ordinary road material. The whole of the considerable traffic entering the Speke factory now passes over all four surfaces. These tests are intended to substantiate claims that the rubber treatment lasts longer, costs less and reduces skidding. If this is firmly established, it is believed that demand upon the rubber industry will be considerable.

SOUTH AFRICA'S METALS AND MINERALS

Higher Production and Export Levels

OUTPUT of most metals and minerals in the Union of South Africa increased in 1949 by comparison with 1948. Side by side with this increased production there was an increase in the volume of exports. In 21 of the 26 base minerals exported increased tonnages were recorded, and the value of base mineral exports during the year totalled £11,624,296 compared with £7,311,183 in the previous year, according to statistics issued recently by the S.A. Department of Mines and quoted by *The South African Mining and Engineering Journal.*

Antimony production from the Consolidated Murchison increased from 7437 tons to 7990 tons, all of which, save 17 tons sold locally, was exported to the United Kingdom.

The output of asbestos during the year showed a considerable increase. Amosite output rose from 30,372 to 41,974 tons; anthophyllite production was 154 tons against a nil return in the previous year; the output of chysotile increased from 4441 to 7609 tons; Cape blue output increased from 8301 to 11,999 tons; and output of Transvaal blue has also increased appreciably. Export figures also showed a considerable increase. Amosite exports rose from 27,635 to 39,269 tons; chrysotile from 1279 to 5142 tons; Cape blue from 7826 to 11,290 tons; and Transvaal blue from 1810 to 7727 tons.

Beryllium and Bismuth

The output of beryllium ore, carrying an average of 10.30 per cent BeO, increased from nil to 246 tons. The whole of the output was exported, the United States taking the major part of the output at a price of over £95 per ton. Bismuth production increased from one to 12 tons, all of which was exported to the United Kingdom and fetched almost £200 per ton.

Copper production during 1949 totalled 32,758 tons against 31,960 tons in 1948. Exports of fire-refined and blister copper totalled 33,081 tons against 25,880 tons in 1948. The output of corundum in crystal form increased from 438 tons in 1948 to 583 tons in 1949. The output of corundum concentrates showed a slight fall from 2359 tons to 2133 tons.

The production of lead concentrates in 1949 totalled 290 tons against 223 tons in 1948. Exports in 1949 amounted to 141 tons compared with 107 tons in 1948, the bulk of the output going to Belgium.

The output of manganese during 1949 more than doubled the 1948 output, the relative figures being 722,211 and 304,673 tons. Exports during the year totalled 763,662 tons against 354,860 tons. The U.S.A. bought 418,033 tons of the 1949 output, while the United Kingdom took 112,000 tons.

Production of Mineral Pigments

Production of mineral pigments also showed an increase during 1949. Ochre totalled 6656 tons against 5157 tons, and oxide production dropped from 3177 tons to 2048 tons, but umber output increased to 910 tons from 641 tons. Exports of ochres totalled 4707 tons compared with 4682 tons in 1948, while 97 tons of oxides were exported where none had been exported in 1948. Britain took the bulk of the ochres exported.

The production of nickel, contained in matte, totalled 625 tons in 1949 against 505 tons in 1948. Exports including quantities left from the previous year's output, amounted to 680 tons valued at £136,023, compared with 454 tons in 1948 valued at £75,661. All was exported to the United Kingdom.

The output of platinum and platinum group metals showed a considerable rise from 68,926 oz. in 1948 to 87,375 oz. in 1949. Exports during the year totalled 94,094 oz. compared with 64,579 oz. in 1948, the whole going to the United Kingdom. The output of tungsten during 1949 totalled 418 tons compared with 157 tons in 1948. Exports during the year totalled 309 tons valued at £85,929, compared with 116 tons valued at £37,896 in 1948. The bulk of the exports went to the United Kingdom.

Vermiculite production showed a big increase, the output totalling 23,364 tons compared with 13,809 tons in the previous year. Exports amounted to 10,637 tons valued at £53,314, compared with 8422 tons valued at £34,221 in 1948. The U.S.A. was the principal purchaser, although considerable tonnages were shipped to Canada, the United Kingdom, and Holland, all of which took over 1000 tons of vermiculite during the year. During 1949, 29 tons of zinc blend were produced and all of it was exported to Belgium.

SOURCE OF VERSATILE COMPOUNDS

Many Uses of Meta-Benzenedisulphonic Acid

FRESH importance is being attached to meta-benzenedisulphonic acid, a new industrial chemical of special interest as an electrolyte additive for the electroplating of nickel (U.S. Patent 2,402,801). Here the acid serves to give a deposit of superior lustre, ductility and bonding power with the base metal.

In the manufacture of plastics this strong acid is finding value as an acid curing agent or catalyst for phenolic, urea, melamine and resorcinol resins, and it has been suggested as a catalyst for esterification, condensation and related acid catalysed reactions.

Potentially important resins can be made by reacting meta-benzenedithiol with poly-unsaturated compounds (U.S. Patent 2,411,954). The intermediate chemical, meta-benzenedithiol, is produced in two stages (1) by heating the alkali salt of meta-benzenedisulphonic acid with phosphorus pentachloride to form the acid chloride; (2) reduction of the acid chloride with tin and hydrochloric acid to yield dithioresorcinol (meta-benzenedithiol).

The sodium salt of meta-benzenedisulphonic acid is soluble in water and is useful as a solubilising agent for water-insoluble phenols in the preparation of disinfectants, pharmaceutical preparations and cosmetics. An old German patent, 181,288, taken out in 1907 by Friedländer discloses this process.

As Intermediate

Of importance is the use of meta-benzenedisulphonic acid as an intermediate for the preparation of dyestuffs, drugs, leather tanning agents and photographic chemicals.

In practically all reactions meta-benzenedisulphonic acid reacts as a difunctional compound and difunctional sulphonic derivatives are readily obtained. Meta-benzene disulphonamide is useful as an intermediate in the preparation of pharmaceuticals.

The disulphonamide is prepared by the treatment of the acid chloride with alcoholic ammonia (Maarse, *Rec. trav. chim.*, *33*, 219 (1914) and Noelting, *Ber. 8*, 1113 (1875)). This sulphonic derivative is only sparingly soluble in water. On reaction of the disulphonamide with hypochlorous acid (Chattaway, *J. Chem. Soc.* 87, 155 (1905)) halogenated amides are formed.

Meta-benzenedisulphonic acid can be used as a starting material for the production of resorcinol (Barth and Senhofer, *Ber. 9*, 969 (1876) and Degener *J. prakt. Chem. 2*, 20, 314 (1879)). The acid is fused at a high temperature with concentrated caustic solutions to give high yields of resorcinol. Fusion of metabenzenedisulphonic acid with potassium cyanide gives isophthalonitrile (Barth & Senhofer, *Ber, 8*, 1478 (1875)).

Yields of meta-phenylenediamine can be obtained by fusing the potassium salt of the acid with sodamide (Jackson and Wing, *Am. Chem. J. 9*, 77/1887). The nitration of this strong acid with concentrated nitric acid or mixed acid gives 4-nitro-meta-benzenedisulphonic acid and 5 - nitro - meta - benzenedisulphonic acid (Heinzelmann, *Aun. 188*, 159 (1877)) from which 4-amino-benzenedisulphonic acid and the 5-amino-meta-benzenedisulphonic acid can be obtained by reduction of the nitro group.

Other interesting compounds formed include 1,3,5-benzenetrisulphonic acid, made by heating meta-benzenedisulphonic acid with concentrated sulphuric acid: meta-benzenediphenyldisulphone by reacting the meta acid with benzene in the presence of phosphorus pentoxide and meta-benzenedithiosulphonic acid (as alkali metal salt) by heating a concentrated aqueous solution of an alkali metal salt of meta-benzenedisulphonic acid with finely divided sulphor.

Meta-benzenedisulphonic acid is a grey, crystalline and highly hygroscopic compound, very soluble in water, soluble in ethyl and methyl alcohol and acetone but insoluble in hydrocarbon type solvents. This dibasic acid is highly corrosive and protective clothing and goggles must be worn when handling it in bulk.

Loss of U.S. Potash

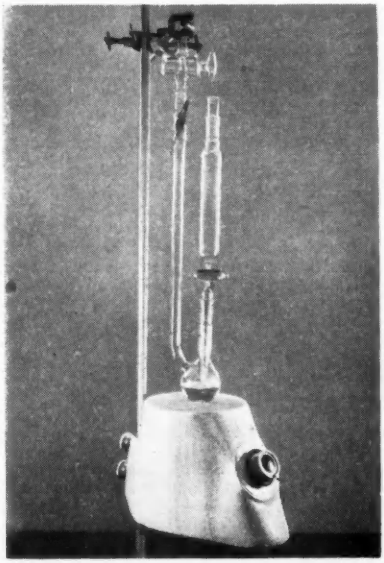
A strike in the potash mines of the Carlsbad district of New Mexico in November and December caused a decline in production and sales of potash in the U.S.A. in 1949. Production and sales totalled 2,056,609 short tons, a decrease of 81,884 from the 1948 peak of 2,138,493 short tons. Total value of sales in 1949 was $35.105,799, nearly $900.000 less than the previous year, while stocks at the end of the year fell to the low level of 9066 short tons K_2O.

PRODUCING RADIOACTIVE CARBON

Supply Ministry Exhibits at the Radiology Exhibition

FROM the industrial viewpoint, perhaps the most interesting aspect of the technical exhibition of X-ray and electromedical apparatus held in London this week in conjunction with the sixth International Congress of Radiology was the Ministry of Supply stand, which showed the work of the radiochemical centre at Amersham. The chemists at Amersham are engaged on the production of C^{14}, which is one of the six isotopes of carbon, four of which are radioactive, the other two being C^{12} and C^{13}, which are the normally known isotopes.

C^{14} is of interest because of its wide potential applications—as a tracer to detect the distribution of carbon in steels, or to reveal the behaviour of wetting agents and detergents in mineral flotation, the lubricating and fuel properties of petroleum fractions and in many other functions.



Part of the fully enclosed synthesis apparatus in the base of which a rotating magnetic field spins a glass-coated steel agitator

The relatively simple principle involved is the same as that of the other tracer elements. A compound in which part of the ordinary carbon (the C^{12} and C^{13} isotopes) has been replaced by C^{14} is said to be "labelled" and all or part of it can be identified afterwards by its radioactive properties. Since natural carbon and C^{14} have the same chemical properties, the C^{14} can be substituted for the normal carbon in any chemical process without disturbing the system. A "labelled" compound can, of course, be followed through the most complicated chemical and biological processes, often to give information not otherwise obtainable.

Detection of Tracer

During many organic processes, C^{14} becomes diluted in a large amount of inactive carbon and thus the effectiveness of C^{14} as a tracer depends upon the sensitivity with which it can be detected. This is, in fact, extremely high. Generally, a Geiger counter, with a window to admit the soft radiation, and the usual scaling equipment, are sensitive enough to detect one part of C^{14} in ten million of ordinary carbon.

For the same reason it is important that the proportion of C^{14} in the starting material shall be as high as possible. In material from the Harwell pile the proportion of C^{14} atoms is usually between 2 and 5 per cent of the inactive carbon. Since C^{14} has a long half-life (5000 years), this ratio does not change appreciably with time.

The C^{14} is made by protracted irradiation of nitrogen. Potassium nitrate is packed into aluminium cans, each containing about 5 oz., which are inserted into the pile. It requires about one year of irradiation before the cans contain the newly formed isotope in combination with oxygen in the potassium nitrate crystals. Dilute perchloric acid is added to liberate radioactive carbon dioxide, leaving the unchanged material in solution. The CO_2 is absorbed in caustic soda and converted to barium carbonate, a compound that is conveniently stored.

It should be noted that, because the weight of C^{14} formed is very small, no carbon dioxide, either from water or from the atmosphere, must be allowed to dilute the radioactive carbon. Further,

it is imperative that the removal of the C^{14} from the solution shall be exceptionally thorough.

To remove carbon dioxide from the acid, nitrogen is bubbled through it for several hours. When no inactive CO_2 remains in the apparatus the acid is transferred to a CO_2-free flask containing about 50 cans of irradiated potassium nitrate. The radioactive CO_2 is removed in a stream of nitrogen and taken up in a glass absorption column through which caustic soda is pumped. The solution is withdrawn and the product separated by precipitation as barium carbonate.

Difficulties of Synthesis

The synthesis of C^{14} into labelled organic compounds is complicated by the following considerations:

(1) The tiny quantities of substance used.

(2) Products formed are generally volatile liquids or gases.

(3) The products are toxic and valuable.

(4) The usual convenient methods of organic synthesis do not apply.

(5) The small yield makes the testing of purity very difficult.

The first three difficulties preclude carrying out the syntheses in the usual flasks and beakers. This difficulty has been overcome by performing the entire series of operations in a totally enclosed glass apparatus from which all air has been evacuated. During the experiment, the reagents are moved from one part of the apparatus to another by condensing their vapour by extreme local cooling. The receiving limb, for example, is usually cooled in a liquid nitrogen to $-147°C.$, at which temperature most materials can be condensed quantitatively.

Losses of Material

The syntheses are often carried out in several stages, frequently with many intermediate steps. Consequently, the inevitable small losses of material at each step are accumulative. Thus, in a ten-stage synthesis, where the yield at each stage is 90 per cent, we have

$(0.9)^{10}$ approximately equals 0.348

giving an overall yield of only 34.8 per cent. Considerable effort is therefore devoted to the improvement of yields in such syntheses.

The chemical routes used in the syntheses are well illustrated in the following typical summary of the preparation of some organic compounds, all "labelled" in the methyl group.

The radioactive CO_2 liberated from barium carbonate by perchloric acid is absorbed in lithium aluminium hydride, where it is reduced to methanol. The "labelled" methanol is refluxed with hydriodic acid to produce methyl iodide. This is then agitated with aqueous caustic potash to form acetonitrile, which may then be hydrolysed with caustic soda to give sodium acetate.

Aqueous acetic acid is made from the sodium acetate by acidifying and then distilling; the acetic acid itself is converted to lithium acetate by addition of lithium hydroxide. Lithium acetate may then be pyrolysed to form acetone, which can be reduced with lithium aluminium hydride to isopropyl alcohol. By reacting this with phosphorus and iodine, isopropyl iodide is produced, and then condensed with acetamidomalonic ester to give diethyl isopropyl acetamido malonate. The condensation product is then hydrolysed with hydrogen bromide to form di-valine, again "labelled" in the methyl group:—

$$(\overset{*}{C}H_3)_2CH.CH(NH_2).COOH.$$

The usual physical measurements such as melting or boiling points, to determine the purity of the products, are not often used; it is preferred instead to rely on an analysis of the C^{14} content by radioactive measurement.

* The C^{14} atom.

French Analytical Congresses

THE Societé de Chimie Industrielle will hold its 23rd industrial chemistry congress at Milan, from September 17-23.

The branches of chemistry to be dealt with in papers at the 22 sessions are: agricultural, analytical, biochemistry, pharmaceutical, physical and general chemistry, inorganic, the chemistry of metals, organic, therapeutical, the chemistry of food, combustibles, fermentation, textile fibres and plastic materials, cements, ceramics and glass, insecticides and disinfectants, dyestuffs, fats and derivatives, explosives; essences and perfumes, chemical technology, radioactive materials.

The Societé de Chimie Industrielle, with the collaboration of the Groupement Technique de l'Analyse et des Essais, is organising a congress of analysts in Paris, from November 20-24. The congress will be divided into these five sections: laboratory apparatus, physio-chemical techniques, organic chemical analysis, mineral chemical analysis, hygiene and biochemical analysis.

Aluminium Explosion Hazards

Violent Reactions with Chlorinated Hydrocarbons

FIELD reports in the U.S.A. attributing fires or explosions caused by the reaction of aluminium with carbon tetrachloride or methyl chloride decided the Underwriters' Laboratories, Inc. to investigate.

The report which was produced recorded that tests under various conditions were conducted using magnesium powder or aluminium exposed in contact with carbon tetrachloride, methyl chloride, trichloroethylene, dichlorofluoromethane, or carbon tetrachloride-chloroform mixtures.

HAZARDS of using carbon tetrachloride and aluminium were referred to by the senior chemical inspector of H.M. Factory Inspectorate in his report on a fatal explosion which occurred at the works of the Northern Aluminium Co., Ltd., Banbury (Oxon) in May (THE CHEMICAL AGE, *63*, 6).

The fact that explosions or fires may accompany the reaction of aluminium with chlorinated hydrocarbons, such as carbon tetrachloride or methyl chloride, was not unknown. In 1945 *an investigation in the U.S.A. on the "Reactions of Aluminium and Magnesium with Certain Chlorinated Hydrocarbons", was prepared by C. C. Clogston, B.S.Ch.E., physical chemist for the Underwriters' Laboratories, Inc., and published by them as Bulletin of Research No. 34.* Some of the primary facts of that investigation are abstracted here.*

Among other results the tests indicate that aluminium powder in contact with methyl chloride, carbon tetrachloride, or a carbon tetrachloride-chloroform mixture is capable of explosion; methyl chloride in contact with aluminium may form spontaneously combustible aluminium methyl.

A bomb containing aluminium powder and carbon tetrachloride exploded violently after heating to 152° C. (305.6° F.) in 53 minutes.

Fifteen tests were carried out at ordinary or moderately elevated temperatures, as follows: No. 1, aluminium turnings and carbon tetrachloride; No. 2, aluminium tubing and methyl chloride; Nos. 3-12, aluminium or magnesium powder and methyl cloride, carbon tetrachloride, trichloroethylene, or dichlorodifluoromethane; Nos. 13 and 14, aluminium powder and carbon tetrachloride or trichloroethylene (vapour phase); No. 15, aluminium powder and carbon tetrachloride (heated).

With the exception of test No. 1, results are summarised in Table 1. During the boiling of the carbon tetrachloride in the first test, the aluminium turnings became black and rough, with a corroded appearance. The carbon tetrachloride gradually acquired a purple colour, states the report, and after boiling for 25 minutes, the action became self-sustaining: that is, the boiling and refluxing continued for half-an-hour without application of external heat.

Rate of Reaction

The temperature of the liquid gradually increased, refluxing beginning at a temperature of 72.5° C. (162.5° F.) and increasing to 88° C. (190.4° F.) after an hour. After the first hour, no further reaction was evident. The boiling temperature increased slightly with time, the maximum being 90° C. (194° F.)

The results of the tests indicated, in addition to the primary findings already mentioned, that at ordinary temperatures (29.4° C. or 85° F.) and in the presence of a small amount of aluminium chloride as a catalyst, aluminium powder and methyl chloride reacted, first with the gradual formation of gaseous pressure in a closed bomb, and after 41 days with more rapid pressure rise to more than 1800 p.s.i. (see Test No. 4). The residue from the reaction readily ignited spontaneously on contact with air or water, and burned especially vigorously on water.†

While aluminium chloride, a catalyst, was present in the test to accelerate reaction, it must be remembered that aluminium chloride is a product of the reaction, and the reaction is, therefore, autocatalytic. This would indicate that in the initial absence of aluminium chloride, the reaction might eventually occur, though it would be expected to

* Underwriters' Laboratories, Inc., 207, East Ohio Street, Chicago, 11.

† This behaviour is characteristic of aluminium methyl, and indicates the presence of this compound in the residue. The formation of this compound has been noted by others (*see Ansul News Notes*, Vol. 1, No. 2, of Ansul Chemical Co., Marinette, Wis.).

TABLE 1

TESTS IN BOMBS AT ORDINARY OR MODERATELY ELEVATED TEMPERATURES

Test No.	Contents of Bomb (Powdered Metals Used)	Temperature Deg. C.	Temperature Deg. F.	Gauge Pressure (P.S.I.)	Duration of Test, (Days)	Results
2	45 g CH_3Cl	29.4	85.0	79	90	No appreciable reaction.
3	60-70 g Al, 140-220 g CH_3Cl	29.4	85.0	79	65	Small volume of H_2 formed; no other appreciable reaction.
4	Same as Test No. 2+0.5 g $AlCl_3$	29.4	85.0	79 to more than 1800	41	Gradual pressure increase to 128 p.s.i. above vapour pressure of CH_3Cl, a more rapid increase to more than 1800 p.s.i. with rupture of disc followed by spontaneous combustion of escaping gases. CH_4 and a spontaneously combustible residue of $Al(CH_3)_3$ were left in bomb.
5	60 g Al, 80 ml CCl_4-$CHCl_3$ mixture†	29.4	85.0	0 to more than 1800	47	Reaction with pressure increase to more than 1800 p.s.i. rupture of disc, and spontaneous combustion of escaping gases. C, $AlCl_3$, and $COCl_2$ formed.
6	Same as Test No. 5+0.5 g $AlCl_3$	29.4 to 43.3	85.0 to 110.0	0 to more than 1800	35	Same as for Test No. 5.
7	112 g Mg, 110 ml CCl_4-$CHCl_3$ mixture†	29.4 to 43.3	85.0 to 110.0	0	69	Slight reaction, traces of chlorides and of acids formed.
8	195 g Mg, 295 g CH_3Cl ...	43.3	110.0	118 to 0	133	Slight reaction, some $MgCl_2$ formed.
9	60 g Al, 136 g CCl_2F_2 ...	43.3	110.0	140 to 0	84	Slight reaction, some $AlCl_3$ formed.
10	60 g Al, 132 g CCl_2F_2, 0.1 g H_2O	43.3	110.0	130 to 0	130	Slight reaction; $AlCl_3$ formed in small amounts.
11	60 g Al, 80 ml CCl_4 ...	43.3	110.0	0	250	Some $AlCl_3$ formed, and also small volumes of CO_2, CO, H_2 and CH_4.
12	60 g Al, 100 ml C_2HCl_3 ...	43.3	110.0	0	150	Slight reaction; traces of acid and chlorides found in darkened liquid.
13	60 g Al, 80 ml CCl_4 ...	33.0 to 43.3	91.4 to 110.0	0	250	Some reaction; liquid became slightly acid, contained some chlorides and yellow organic solid. $AlCl_3$ formed.
14	6p g Al, 100 ml C_2HCl_3 ...	33.0 to 43.3	91.4 to 110.0	0	150	Slight reaction; traces of chlorides formed in metal and in liquid.
15	60 g Al, 110 ml CCl_4 ...	17.0 to 152.0	62.6 to 305.6	0 to more than 1800	53 min.	Reacted with sudden and violent explosion, rupturing bomb. $AlCl_3$ and C formed.

† 8.3 per cent by volume $CHCl^3$.

occur more slowly. Thus, under similar conditions, in the absence of aluminium chloride, no reaction of aluminium powder and methyl chloride occurred in 65 days, except possibly the formation of a small amount of hydrogen (see Test No. 3).

When maintained at only slightly elevated temperature (from 29.4° to 43.3° C. or 85° to 110° F.) for 35 and 47 days, aluminium powder in contact with carbon tetrachloride containing some chloroform (8.3 per cent by volume) reacted with pressure in excess of 1800 p.s.i., and with flame, forming carbon and aluminium chloride (Tests No. 5 and 6).

Powdered aluminium ignited promptly and burned in the vapour of such a carbon tetrachloride-chloroform mixture at one atmosphere pressure, and at a temperature of 286° to 312° C. (547° to 594° F.), (Test No. 22).

Powdered aluminium and carbon tetrachloride heated together in a bomb at constant volume under the vapour pressure of carbon tetrachloride suddenly exploded at 152° C. (306° F.), rupturing the bomb and forming aluminium chloride and carbon; large volumes of light grey smoke were present (Test No. 15).

At lower temperatures (43.3° C. 110° F.) powdered aluminium and carbon tetrachloride vapour were heated together in

TABLE 2

TIME-TEMPERATURE-PRESSURE DATA DURING HEATING OF ALUMINIUM POWDER AND CARBON TETRACHLORIDE IN BOMB (Test No. 15)

Time Min.	Temperature of Bomb Deg. C.	Deg. F.	Calculated Pressure, P.S.I. Gauge, Based on Vapour Pressure and Air Expansion	Reading of Gauge on Bomb P.S.I.
0	17.0	62.6	0.0	0
5	17.0	62.6	0.0	0
10	21.0	69.8	0.7	0
15	27.0	80.6	1.4	0
20	36.0	96.8	3.0	0
25	52.0	125.6	7.0	0
30	68.0	154.4	12.0	0
35	87.0	188.6	22.0	0
40	108.0	226.4	38.0	25
45	126.0	258.8	57.0	45
50	143.0	289.4	82.0	65
53	152.0	305.6	97.0	Explosion

A NEW MONOMER FOR THERMOPLASTICS

Interesting Characteristics of 2-Vinyl Pyridine

THE possibility of synthesising new resins is suggested by the recent development of 2-vinyl pyridine. This monomer, which is characterised by its pungent odour, is soluble in water to the extent of about 2.5 per cent and freely soluble in dilute aqueous acid solutions. It dissolves in all the common organic solvents, such as aromatic and aliphatic hydrocarbons, alcohols, ketones, esters, etc.

The monomer polymerises at room temperature to form hard and tough transparent thermoplastic resins. Normally an inhibitor is present to prevent premature polymerisation, but the inhibitor can be eliminated by vacuum distillation. Ultra-violet light hastens polymerisation, as do catalysts (or activators) such as benzoyl peroxide in percentages of 1-2.

If polymerisation of 2-vinyl pyridine is carried out at elevated temperatures (the monomer boils with resinification at about 159° C. at 760 mm. Hg.) a viscous resin is formed. In common with many other well known monomers, 2-vinyl pyridine can be polymerised if emulsified with an aqueous solution of ordinary soap, sodium oleate and other emulsifying agents (5-10 per cent strengths are usual) using a peroxide catalyst, *e.g.*, benzoyl peroxide or lauryl peroxide.

The polymerised material is soluble in most common organic solvents and it is considered likely that such solutions might be of interest as coatings and adhesives. Dilute aqueous mineral acids convert the resin into a highly viscous solution.

Of particular interest is the fact that 2-vinyl pyridine can be co-polymerised with butadiene and styrene to give elastomeric resinous products possessing useful properties. These have not yet been fully investigated, so far as recent publication indicates, but they promise to be of interest for applications not unlike those of polyvinyl chloride and polyvinyl chloride acetate.

2-vinyl pyridine has so far only been produced in development quantities for market appraisal by the chemical industry. Reilly Tar and Chemical Corporation, Indianapolis, U.S.A., has taken a prominent part in pioneering this monomeric chemical.

Considerable care is necessary in handling 2-vinyl pyridine, which, like most other volatile pyridine derivatives, possesses lachrymatory properties. The liquid will cause blistering of the skin in a few minutes.

This new chemical is very reactive. It can be readily oxidised, as with potassium permanganate, to give picolinic acid. Hydrogenation gives ethyl pyridine and 2-ethyl piperidine. With acids the monomeric compound yields hygroscopic salts which are soluble in water but insoluble in most organic solvents.

ALUMINIUM EXPLOSION HAZARDS

(*continued from previous page*)

a bomb for more than eight months with no reaction other than some formation of aluminium chloride in the aluminium powder and a small amount of yellow organic solid dissolved in the carbon tetrachloride. At this temperature, however, contact of liquid carbon tetrachloride with aluminium powder resulted in the formation of larger amounts of aluminium chloride in the aluminium, and various gases, including carbon dioxide, carbon monoxide, gases absorbed by sulphuric acid, hydrogen, and methane (Tests No. 11 and 13).

At temperatures of the order of 400° C. (752° F.), aluminium powder ignited and burned in dichlorodifluoromethane at one atmosphere pressure, aluminium chloride, free carbon (and probably aluminium fluoride) being formed. However, powdered aluminium in contact with dichlorodifluoromethane at a temperature of 43.3°C. (110° F.) for 4½ months caused only the formation of small amounts of aluminium chloride without building up pressure, or producing other marked evidence of reaction (Tests No. 10 and 27).

No marked reaction occurred between powdered aluminium and trichloroethylene, either when heated at temperatures up to 427° C. (801° F.) or when maintained in contact for five months at 43.3°C. (110°F.) Similiar negative results were obtained with magnesium and methyl chloride in contact in a bomb at 43.3° C. (110° F.) for 4½ months, or a carbon tetrachloride-chloroform mixture containing 8.3 per cent by volume chloroform in contact with powdered magnesium for more than two months (Tests No. 7, 8, 12, and 25).

Upon receiving hammer blows in the impact tests, aluminium or magnesium with carbon tetrachloride, chloroform, or trichloroethylene did not readily explode.

Elastic Materials Research

Mellon Institute Developments in 1949

TWO of many interesting researches carried out at the U.S. Mellon Institute during 1949 were concerned with elastic materials. The first of these, dealing with the reinforcement of rubber by pigments, was the task of the Rubber Fellowship, sponsored by the Firestone Tyre Co., of Ohio.

An initial project was designed to ascertain the effects of various rubber pigments upon the consistency of high-solids filler-liquid pastes. It was disclosed that, for a series of carbon blacks suspended in mineral oil, the yield points at equivalent concentrations of the blacks were proportional to the inverse squares of their particle diameters.

Calcium Carbonate

This relationship demonstrates qualitative correspondence to the well-known increased reinforcing powers of the smaller diameter blacks. For all the pigments studied, the "consistency" of the paste was found to increase as the fourth power of the volume concentration.

It has also been determined that non-black pigments, such as calcium carbonate, stiffen mineral oil pastes to about the same degree as a carbon black having equivalent particle diameter. But, when other liquids, such as linseed oil, are used as media, calcium carbonate pigments produce suspensions of very much lower consistency than carbon black dispersions possessing equivalent concentration. Moreover, fatty acids lower greatly the stiffness of a calcium carbonate, but not of a carbon black paste.

It is felt that some of these findings may contribute to expounding the mechanism of the reinforcement of rubber by carbon black.

The second of these researches had for its object an improvement in the physical properties of the rubber-like silicone, or Silastic. Both tensile strength and elongation have been greatly improved, and the tear resistance has been increased three-fold.

Silicone treatments for the waterproofing of textiles have been developed and are already coming into commercial use. A treatment of paper has resulted in a product that is extremely water-repellent and that prevents the adhesion of pressure-sensitive tapes, rubber, asphalt, and many other normally adhesive materials.

In the electrical field, a silicone bonding enamel for glass-served magnet wire has been developed. There have also been improvements during 1949 in silicone lubricants for use at both high and low temperatures. An entirely new line of silicone intermediates for use in resins and paints has been evolved.

The silicone product for controlling foam in aqueous systems is one that finds the broadest diversification of employment. It is accepted for use in edible products at its effective range of concentration, *e.g.*, up to 10 p.p.m. It controls foaming during wine fermentation, and is generally effective in trace amounts for preventing foam in such widely different media as antifreeze solutions and oxygenated blood. It also relieves cattle suffering from tympanites or bloating.

The descriptions of these researches appear in the 87th annual report of the director of the Mellon Institute, Pittsburgh, U.S.A. Other aspects of Mellon Institute research have been reviewed briefly (THE CHEMICAL AGE, *62*, 893).

WELDING RESEARCH

Laboratories for BWRA

PLANS to increase its laboratory space and install the modern testing equipment were outlined at the fifth annual general meeting of the British Welding Research Association held at Abington, near Cambridge, on July 13.

The paramount necessity of keeping its equipment up-to-date was emphasised by the council, which announced that a pulsating pressure testing plant for fatigue testing pressure vessels had been installed and a large tensile testing machine had been ordered.

These large and expensive equipments, however, demanded considerable laboratory space and the council was therefore planning to build a fatigue testing laboratory at Abington, thus releasing a portion of the old laboratories for much needed expansion of other work. The new laboratory would cost in the neighbourhood of £20,000—much more than the association could spare from its reserves, and an appeal for support would have to be made.

During the past year much valuable work had been undertaken by the research board, and the liaison department had been reorganised.

ORGANO-LITHIUM COMPOUNDS

A Survey of Recent Developments

by R. W. MONCRIEFF

UNTIL fairly recently the greatest claim that lithium had to the organic chemist's attention was that its urate was moderately soluble in water; thus, lithia water was prescribed for the treatment of gout and similar ailments, supposedly caused by the lodgment of uric acid crystals in the joints.

To-day, matters are very different indeed and a great number of organic lithium compounds are used. Ordinarily they are not end products, but intermediates designed to assist a synthesis in a similar way to that in which magnesium Grignard agents are so successful as intermediates, but of little interest *per se*.

Delayed Introduction

It is perhaps one of the most surprising features of the chemistry of the organo-lithium compounds, that their introduction and use were so long delayed. For many reactions magnesium was too sluggish to be useful, and the substitution of a light alkaline earth metal by an alkali metal must have seemed the obvious step to take in order to obtain the desired increase in reactivity. Why was this step not taken earlier? The probable reason is that the alkali metals, particularly sodium, were well known to convert alkyl and aryl halides into hydrocarbons; this was, of course the well-known **Wurtz-Fittig reaction** and one of the standard methods of preparing hydrocarbons.

In 1855, Wurtz[1] had reacted sodium with ethyl iodide to form butane:

$$2C_2H_5I + 2Na \rightarrow C_4H_{10} + 2NaI.$$

In 1864, Tollens and Fittig[2] applied the same method to the preparation of the homologues of benzene, *e.g.*, bromobenzene and methyl iodide react, to give toluene:

$$C_6H_5Br + CH_3I + 2Na \rightarrow C_6H_5.CH_3 + NaBr + NaI.$$

It was only much later, in 1930, that Ziegler and Colonius[3] established that when metallic lithium was reacted with alkyl or aryl halides, the organo-lithium derivatives are formed in good yield, according to the equation:

$$RBr + 2Li \rightarrow RLi + LiBr.$$

Using similar symbols, the Wurtz-Fittig reaction may be represented as follows:

$$2RBr + 2Li \rightarrow R — R + 2LiBr.$$

How are these reactions reconciled?

The answer is that Wurtz-Fittig reaction proceeds in two stages and the organo-metallic compound is an intermediate. The first stage is:

$$RBr + 2Li \rightarrow RLi + LiBr \quad \ldots\ldots \quad (1)$$

and this is followed by the reaction between the organo-metallic compound RLi and some of the unchanged halide, thus:

$$RLi + RBr \rightarrow R — R + LiBr \quad \ldots \quad (2)$$

Adding the two equations (1) and (2) we arrive at:

$$2RBr + 2Li \rightarrow R — R + 2LiBr,$$

which is the equation for the Wurtz-Fittig reaction.

When sodium or potassium was used as the alkali metal, the second stage followed so quickly on the first, that it was not realised that the Wurtz-Fittig reaction proceeded through the intermediate organo-metal compound. When lithium is used it is considerably less active than either sodium or potassium, and it is therefore possible to detect the formation of the organo-lithium compound. Ziegler and Colonius found, in fact, that the lithium derivatives are formed in good yield, because they react only slowly with the organic halide still present.

Although the reactivity of the organo-lithium compounds is much lower than that of the corresponding sodium and potassium compounds, it is nevertheless greater than that of the organo-magnesium compounds. The order of reactivity is

$$RK > RNa > RLi > RMg(Br).$$

Gilman and Young showed that the caesium and rubidium organo compounds were even more reactive.

The greater reactivity of the alkali metal compounds, as compared with those of magnesium opens up the possibility of using new syntheses, *e.g.*, alkali metal compounds are capable of adding to an ethylene linkage, whereas magnesium compounds are not. Thus, Gilman and Kirby[4] showed that benzophenone-anil $(C_6H_5)_2C:NC_6H_5$ "reacts decidedly slowly, if at all, when refluxed with phenyl magnesium bromide in ether." But phenyl-lithium will react with benzophenone-anil in ether and the product obtained is triphenylmethylaniline:

$$(C_6H_5)_2C:NC_6H_5 + C_6H_5Li \rightarrow (C_6H_5)_3CNHC_6H_5.$$

In addition to this general difference of

degree of reactivity, there are also differences in the kind of reactivity. Thus, Gilman and Bailie[4] showed that, whereas magnesium derivatives reduce azobenzene to hydrazobenzene (plus a small proportion of aniline), the potassium derivates will add on to it, *e.g.*, phenyl-potassium adds unsymmetrically to azobenzene to give triphenylhydrazine. In this instance lithium behaves like magnesium and, by symmetrical addition to the azo linkage, gives mostly hydrazobenzene:

$$C_6H_5N:NC_6H_5 + 2C_6H_5Li \rightarrow C_6H_5.C_6H_5 + C_6H_5N(Li)\text{-}NC_6H_5$$

$$\xrightarrow{H_2O} C_6H_5NH.NHC_6H_5$$

On the other hand, triphenylhydrazine results by unsymmetrical addition of the highly reactive phenyl-potassium.

$$C_6H_5N:NC_6H_5 + C_6H_5K \rightarrow (C_6H_5)_2N.NC_6H_5 \quad (K)$$

$$\xrightarrow{H_2O} (C_6H_5)_2N.NHC_6H_5$$

The greater reactivity of organo-lithium compounds requires that reactions in which they are used must be carried out in an inert atmosphere, whereas the corresponding magnesium derivatives do not need this protection. Cylinder nitrogen, provided it is dried by calcium chloride and phosphorus pentoxide, is a suitable gas to use as an inert atmosphere; the traces of oxygen that such nitrogen contains will not, as a rule, interfere.

While lithium will react with a variety of compounds, the most suitable are the halides. These must be carefully purified; whereas bromobenzene reacts readily with lithium, the presence of dibromobenzene as an impurity greatly retards the reaction.

Choice of Halides

The bromide is the halide usually preferred; iodides are ordinarily too reactive, since they react rapidly with the alkyl-lithium, so that the organo-lithium compound cannot be isolated, and the reaction goes straight through to the normal Wurtz-Fittig. An exception is methyl iodide, which will give an 80 per cent yield of methyl-lithium in ether solution. The chlorides are less reactive than the bromides; they can be used in the aliphatic, but not in the aromatic series.

The reaction between the halide and the lithium must be carried out in solution in an inert solvent. Ether is generally used, while benzene and cyclohexane are possible alternatives. Though ether accelerates the preparation and reactions of organo-lithium compounds, benzene and cyclohexane slow them down. Accordingly benzene and cyclohexane are most suitable for use in the alkyl series where also the chlorides are sufficiently reactive to be used. In the aromatic series, however, reactivity is so much less that bromides are used with ether as a solvent. It is thus possible to enhance or depress the reactivity of lithium with the halide in two ways: (1) by choice of halide, iodide being more reactive than bromide and bromide more reactive than chloride, and (2) by choice of solvent, ether encouraging the reaction, benzene suppressing it.

A three-necked flask with stirrer, dropping funnel and reflux condenser is a suitable apparatus. A nitrogen atmosphere is maintained, and ether is introduced into the apparatus, followed by the lithium. The metal should be in a form that has a considerable surface: either in flat fragments or as a thin ribbon cut into pieces. When the ether and the lithium are in the reaction flask, a solution of the halide in ether is added. Only a little is put in at first, the rest being allowed in at a rate sufficient to maintain gentle refluxing. When all of the halide has been added, and spontaneous refluxing has ceased, heating is continued for about an hour. The mixture is then allowed to settle and the supernatant liquid transferred to a vessel fitted with a burette.

Determination of Organo-Lithium

The organo-lithium content of the ethereal solution is determined by taking the difference between two titrations.

(1) A known volume of the ethereal solution of the organo-lithium compound is run from the burette into a little water. The lithium immediately forms lithium hydroxide, which is titrated with standard acid using methyl orange as an indicator. This gives the total lithium, most of which will have been present as organo-lithium compound but some, possibly, as lithia from contact with moisture, or as lithium ethoxide from partial decomposition of the ether.

(2) A second aliquot portion of the ethereal solution is coupled with benzyl chloride and the lithium hydroxide and ethoxide in the solution then titrated against standard acid. The difference between the titres is a measure of the organo-lithium compound originally present.

Often the organo-lithium compounds are formed in a yield of 75-95 per cent based

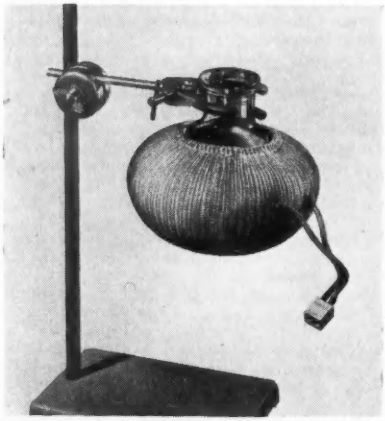
(*continued at foot of next page*)

Electrothermal Heating

New Flexible Glass Fabric Mantles

A NEW series of electrothermal heating mantles designed to meet the need for a light entirely flexible type of heater is now available as an addition to the range of electrothermal aluminium housed mantles and laboratory heating equipment.

This development by Electrothermal Engineering, Ltd., has now reached production stage. The flexible mantles (series MJ) are constructed entirely of glass yarn capable of resisting temperatures up to 550°C., while some special types permit temperatures up to 750°C. to be used.



A flexible heating mantle with elastic neck entry

The flask is inserted into the close-fitting mantle neck; elasticity is imparted to the neck by the combined action of a stainless steel spring and the knitted glass fabric. The elastic nature of the mantle enables either flat or round bottomed flasks and flasks of wide tolerance to be used.

The construction makes the mantle self-adhering to the flask, at the same time providing excellent heat transfer with minimum heat losses incorporated in one piece of equipment. Accuracy of heat control is attained by the use of external energy regulators which reduce the energy input on a proportionate time basis.

Standard sizes of mantles range from flask capacity of 50 to 10,000 millilitres.

Mantles operating at temperatures above 550°C. are not necessarily covered by the test on fire hazards described in the Joint Fire Research Organisation report No. 50.

Australian Industrial X-ray Unit

Precise measuring and optical instruments, which before the war were imported into Australia, are now being made there. A Melbourne company manufactures an industrial X-ray unit, with a range of 30 to 140 kV.P., used for the examination of high alloy castings.

ORGANO-LITHIUM COMPOUNDS

(*continued from previous page*)

on the halide used. Their solutions in benzene or in cyclo-hexane are stable, but ethereal solutions are less stable on account of the tendency of alkyl-lithium compounds to decompose the ether, with the formation of lithium alkoxides.

The above method of estimation is partly due to Ziegler, Crössmann, Kleiner and Schäfer[7] who obtained true titration values by the difference between the titres of two aliquots (1) for the total alkali metal and (2) for the alkali metal after destroying the RLi compound by adding *n*-butyl bromide and then dibenzylmercury. The benzyl-lithium formed by reaction of the RLi compound and dibenzylmercury was at once decomposed by the butyl bromide.

Gilman and Haubein[5] showed, however, that benzyl chloride was a more convenient reagent than the *n*-butyl bromide-dibenzylmercury combination for removing the RLi compound. The alkyl-lithium compounds couple so readily with benzyl chloride that there is no unchanged alkyl-lithium present within one half-minute after mixing the two solutions.

(*To be continued*)

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OVERSEAS CHEMISTRY AND INDUSTRY

India's Aim of Self-Sufficiency

Government's Closer Control of Imports

From OUR CORRESPONDENT

FURTHER evidence is accumulating of unrest in some industries resulting from the increasing development of the Indian Government's policy of securing tighter control of imports, of some basic production processes and of raw materials. The rigid limitation of imports in particular has limited operations in a number of industries and shortage of supplies has tended to produce price increases.

Salt imports to India during the first six months of this year amounted to three million maunds, which together with an anticipated production of 65 million maunds will equal the estimated requirements of the country for the year. The Government has therefore banned the import of salt in the second half of the year.

Self-Sufficiency by 1951

Production of salt has increased in all parts except Travancore, where producers are stated " to have lost all interest " in the industry in view of the Travancore Government's move for nationalisation. Factories in the State have now been taken over by the Government of India.

According to official forecasts, India expects to attain self-sufficiency in salt by the end of this year, a year ahead of the target date of 1951. Meanwhile, the Governments of India and Pakistan have agreed to allow the import of rock salt to India from Pakistan freely without any licensing or payment restrictions.

All stocks of uranium available in the country are to be purchased by the Government of India. This announcement was made recently at New Delhi by the Department of Scientific Research, which is controlled by the Prime Minister, Pandit Nehru.

An Atomic Energy Commission has been established to carry on researches in the application of nuclear fission to constructive purposes. Dealers and mineowners have been asked to contact the commission and send samples of uranium for analysis. Prices paid will be based on the uranium content of the ores or concentrates.

Glass manufacturers have been called upon by Mr. Shri Prakasa, Minister of Commerce, Government of India, to co-operate in the co-ordination of import, production and distribution of glass so as to eliminate monopoly and ensure equitable distribution.

The Minister was replying to representations made by the All India Glass Manufacturers' Association, urging the Government to terminate the use of the import policy as a means of protection to the glass industry.

Profiteering

According to the association, restricted imports, recommended by the Indian Tariff Board and implemented by the Government, are being exploited by the indigenous industry as an opportunity for profiteering. The association urged a thorough investigation into the working of the local industry.

The import policy of the Government and the recommendations of the Indian Tariff Board on the glass industry were also discussed at the fourth conference of the South Indian Glass Manufacturers' Association. Mr. M. V. Gopal Chettiar, secretary of the Salem District Chamber of Commerce, who presided, stressed the need to improve the technique of production while maintaining costs as low as possible. It was also resolved to request the Indian Standards Institution to study the establishment of recognised standards and see that products which attained the required specifications bore the mark of the institution.

Freer Metal Imports

The import of virgin metal and scrap as well as semi-manufactured goods such as are not manufactured in India will, in most cases, be licensed freely from dollar and soft currency areas. This is one of the main features of the Government of India's licensing policy and procedure in respect of import of non-ferrous metals from countries other than Japan for the period July-December, 1950, according to a Commerce Ministry Press note issued from New Delhi. Licences will first be issued on a provisional basis, valid for a period of six months, and will be confirmed on production of evidence of the placing of orders and their acceptance by the suppliers.

GERMAN GLASS & LABORATORY SUPPLIES

Further Impressions of the ACHEMA Displays

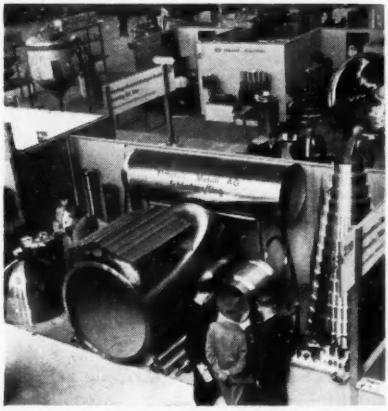
From A SPECIAL CORRESPONDENT

ANY doubt regarding the determination of German suppliers of chemical equipment to regain their important position in the international sphere will not have survived a visit to the ACHEMA exhibition, which reached its conclusion in Frankfurt last week (THE CHEMICAL AGE, *63*, 113-14).

The lesson which is most evident, especially perhaps in the large chemical instrument sections, is that tremendous effort has has been made to offset the great handicaps imposed by wartime destruction and, no less important, the virtual isolation for some ten years from advances made in most other industrial countries.

The economic setting in which this is presented is one of extreme austerity and great seriousness of purpose. Everywhere the exhibition has been treated as being of the highest importance.

Viewed against this background, the exhibition represents a remarkable achievement. Although not reaching the level of scientific development seen at recent exhibitions in this country and in the U.S.A., the average standard of the material presented is very high and many interesting new adaptations or fresh applications of otherwise well-known apparatus have been shown.



A corner of the exhibition in which German development of large-scale metal fabrications was strikingly represented

Sixty-Five Exhibitors

Sixty-five makers of laboratory equipment, including about half a dozen from Liechtenstein, Switzerland, Austria and Denmark and several from the Eastern Zone of Germany exhibited a very wide range of equipment (Hall V).

General Glassware.—Among the many exhibits in the usual range of glassware was a well designed flask with protective reinforcement mounted in a special metal bath for work on materials liable to be explosive (Ernst Haage, Mühlheim a/R.). The same firm also exhibited some "unit" apparatus for narrow range fractionations on normal and micro scale, and some very compact compressed air motors for various uses. The Jenaer Glassworks of pre-war fame were represented both by the company still operating in the Eastern Zone (Schott & Gen., Jena) and by the new company founded in 1945 in Bavaria (Jenaer Glasswerke Schott & Gen., Landshut). Both showed the usual range of large and small scale glass equipment and optical glasses. The Jena firm, however, has a new type of coupling for glass pipe lines (*Bundrohrleitungen*) making use of a one-piece Al/Zn casting held in place by a single screw clip. A newcomer in this field was the firm of Neue Glashütte Papenburg, H. A. Fritsche, Papenburg (Ems). This was built up during the last two years by a group of specialists forced to leave the Eastern Zone of Germany and specialises in scientific glassware for particular applications.

Optical Apparatus

A very large number of the exhibitors showed optical apparatus, mostly of standard design and with few improvements of the 1937 models. Some excellent X-ray equipment was shown by the Röntgenwerk C.H.F. Müller Aktiengesellschaft, Hamburg, 1, which also created considerable interest by demonstrating the use of the only Philips electronmicroscope in Germany.

The new Zeiss works (Zeiss-Opton, Oberkochen) was built up from a nucleus staff of 80 emigrants from the Eastern

Zone works at Jena. On their stand one saw a number of very well finished colorimeters, refractometers and other items of optical equipment, among which the most interesting was a stereo-microscope. This instrument, suitable for magnifications of x6-160, is fitted with a dial operated means for adjusting magnification over five ranges without changing objectives or oculars. It has a very long viewing distance (95 mm. at x80).

Ultrasonic Apparatus

Among the many exhibits of more or less standard design in the department of electrical and sundry physico-chemical equipment were some interesting developments in ultrasonic apparatus (Atlas Werke, A.G., Bremen, and H. Propfe K.G., Mannheim), high-vacuum equipment (DEGUSSA, Frankfurt, and Gerätebau-Anstalt Balzers, Liechtenstein) and an electropolishing apparatus for photomicrographs (H. Struers Chemiske Laboratorium, Copenhagen).

An outstanding feature of the vacuum equipment shown was its very compact construction; in many cases pressure gauges and control devices were an integral part of the body castings, conferring the additional advantage of avoiding some of the usual sources of leakage. The display of *p*H meters was, on the whole, rather disappointing in comparison with some of the equipment now available in this country.

Analytical balances were shown by 11 firms, the models ranging from the simplest to the most complex micro and automatic balances. The Bunge microbalances of pre-war fame were very much in evidence, again showing excellent workmanship.

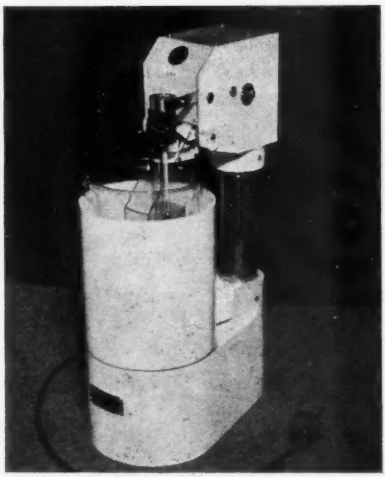
Automatic Balance

The Sartorius-Werke, Göttingen, showed their latest model, the Selecta. This is a fully automatic, aperiodic balance of unusual design with a circular case. All the controls are accessible by one hand at table level, the optical system uses elliptical mirrors to reduce light losses, so that a very low-wattage bulb, with little heating effect, can be used. The cylindrical glass walls of the case slide effortlessly in circular guides.

Another improvement in design is shown by a balance exhibited by August Sauter K.G., Ebingen. This has a projection scale across the full width of the balance case (scale length 300 mm.), electrical damping and shows the sum of the ring-weights in use on a dial immediately next to the projection scale. The same firm also shows some very pleasing torsion balances (air-damped) covering 0-1 mg. to 0-2500 mg. with 11 standard models.

The recent tendency towards single-pan balances is also evident here, the best example probably being the new model exhibited by Wilh. Spoerhase, vorm. Staudinger & Co., Giessen. It is of the constant-load type, *i.e.*, the balance is always preloaded to 100 g. (empty); weights are removed by the automatic device according to the weight on the pan which is suspended from the same lever-arm. All the mechanism is enclosed in the dust-proof main body of the case, only the single pan coming out into the all-glass front weighing compartment. Sensitivity is 0.1 mg., and maximum capacity 100 g.

It was interesting to note the general tendency in constructing laboratory furniture to use tiled tops for nearly all benches, fume-cupboards, etc., due to the scarcity of the materials more commonly used here, such as teak and special sheet materials. One noticed only one new development: a "streamlined" fume-cupboard with curved front. This is claimed to give considerably improved fume removal, and has the additional advantage of being usable in relatively low rooms, as the counter-balanced front slides over the top, like a roll-top desk.



The function of this compact assembly is to measure the digestibility of coatings to be used with pharmaceutical goods (*Ing. Georg Nold*)

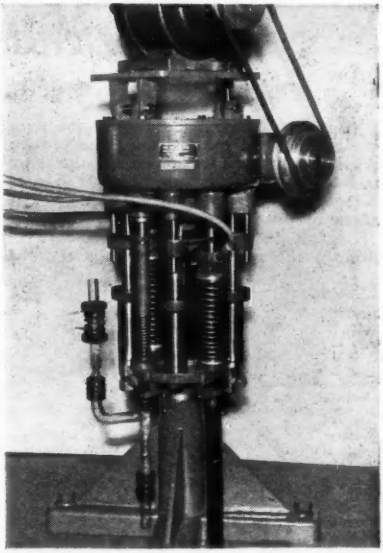
(" RUMA "-Abzug: Rudolf Mauer, Frankfurt a/M.) Fume extraction in general was by relatively small, high-speed centrifugal fans of normal construction.

Among the hundreds of interesting items of laboratory equipment it is possible to mention only a few. A very compact thermostat, adjustable to 0.01 °C., and said to be constant to 0.005 °C. with a bath capacity of 8 litres, and fully compensated connections for separate instruments, was shown by Gebr. Haake, Medingen bei Dresden. By the same firm also were a "cold-accumulator" suitable for use with this thermostat for work at low temperatures (chargeable with ice or solid CO_2), and some very elegant equipment for electrolytic analyses.

Gas Detection

The Drägerwerke, Lübeck, gas-testing device is suitable for the detection and determination of low concentrations of CO, Hg, H_2S, C_6H_6, " nitrous " fumes, etc. A known volume of contaminated air is drawn through small glass tubes containing a suitable reagent absorbed on silica-gel or aluminium oxide. The induction is by a double-acting plunger pump of constant delivery, unaffected by back-pressure caused by the different contents of the various types of tubes.

The tubes have separate filter sections to reduce unwanted side-reactions and can be stored almost indefinitely without loss of sensitivity as they are completely sealed in, and the glass tips are broken only immediately before use. The pump, a selection of tubes, comparison standards, etc., are housed in a compact carrier.



Diaphragm dosing apparatus showing quadruple glass pumps (Ing. Georg Nold)

Other items of interest in this section of the exhibition were an automatic calorimeter which can be coupled to a chart recorder (J. H. Reinecke, Bochumm, Bad Lippspringe), a really silent shaker

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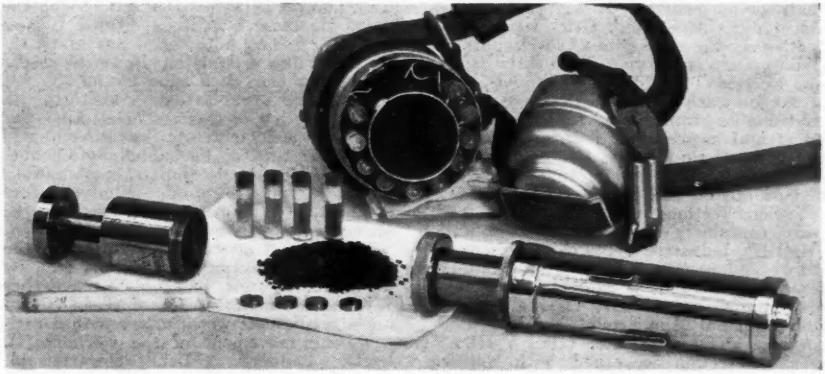

Gas testing equipment (Drägerwerke), of which the opened carrier shows the tubes and the recess for the pump

Rising Production Capacity

Evidence of the Census Returns

THE very marked increase in the value of industrial output since the pre-war period finds fresh evidence in the summaries which have now been issued, presenting the preliminary results of the census of production of 1948.

The ink trade, seed crushing and oil refining, the glue, gum, paste and allied trades steel sheets and tinplate, wallpaper and hair and fibre production are the subjects briefly reviewed in the *Board of Trade Journal* (*159*, 198) and the output figures for 1948 in each case make an arresting contrast with the 1935 and 1937 values. Typical comparisons were in the three industries represented below.

	Printing and Writing Inks			Seed Crushing and Oil Refining			Glue, Gum, Paste, Etc.		
	1948	1937	1935	1948	1937	1935	1948	1937	1935
	£'000	£'000	£'000	£'000	£'000	£'000	£'000	£'000	£'000
Value of production (gross output)	6,783	3,134	2,937	24,525	35,400	26,531	9,866	2,954	2,391
Cost of materials, fuel and electricity used	3,370	1,350	1,202	18,937	29,902	21,486	6,361	1,813	1,317
Amount paid for work given out	—	—	—	5	26	27	—	1	—
Net output	3,413	1,784	1,735	5,583	5,472	5,018	3,505	1,140	1,014
Wages and salaries of persons employed	1,430	—	—	3,329	—	—	1,680	—	—
Average number of persons employed	No.	No.	No.	No.	No.	No.	No.	No.	No.
	3,555	2,956	2,766	9,410	13,596	12,545	4,755	3,767	3,473
Net output per person employed	£	£	£	£	£	£	£	£	£
	900	603	627	593	402	400	737	303	292
	No.	No.	No.	No.	No.	No.	No.	No.	No.
Number of establishments	52	—	58	43	—	62	59	—	53
	£'000			£'000			£'000		
Total value of sales ...	6,888			24,583			9,896		
New plant acquired ...	104			476			331		

GERMAN GLASS & LABORATORY SUPPLIES

(*continued from previous page*)

for up to six standard size sieves (J. Engelsmann, A. G., Ludwigshafen a/Rhine), a very compact apparatus for measuring the "digestibility" of various coatings on pharmaceutical preparations, etc. (Ing. Georg Nold, Griesheim-Darmstadt). By the same firm was a diaphragm dosing pump containing up to three separate sections for different liquids, the stroke on each section being individually controllable from zero to 60 litres per hour; and a precision dosing apparatus containing four all-glass pumps of special design permitting control to an accuracy of 0.04 ml. on a stroke of 12 ml. (max.)

Various sections of the exhibition dealt with containers and packing machines (Hall II), industrial types of gauges, indicators and recorders (Hall IV), grinding, screening, distillation equipment, conveyors, pumps, valves, etc. (Hall VII) and constructional materials, acid-resistant coatings and linings, etc. (Hall VIII).

In the section concerned with valves, pipelines, etc., some very good equipment was exhibited by Amag-Hilpert Pegnitzhütte A.G., Pegnitz-Ofr., in particular the wide range of special pumps for dealing with various mineral acids and corrosive liquors. Paul Bungartz & Co., Düsseldorf-Obercassel, show a very interesting acid resistant pump fitted with a centrifugally controlled valve over the packing. This pump (Type MOR) is said to be the only glandless centrifugal which is also perfectly sealed both when not in operation and during starting up (until reaching 80 per cent maximum r.p.m.).

Ten large organisations specialising in the production of castings of all kinds for the chemical industry have combined under the title of Fachabteilung Chemieguss, Hagen i.W. Similar combinations of other groups of producers of chemical engineering equipment are expected to be formed in the near future.

There were interesting exhibits in the field of centrifuges, rotary filters, etc., by non-German firms such as Dorr, Escher Wyss and the Buss A.G., of Basle (showing a continuous worm mixer with a reciprocating movement of the worm-shaft). Carl Padberg, Lahr/Schwartzwald, showed a laboratory centrifuge (CEPA No. 1) which appeared to be remarkably similar to the familiar Sharples model.

Technical Publications

IN addition to increasing productivity and improving quality by allowing one skilled man to set the timing of processes for less skilled operators, timers, relays and pressure switches can be linked to give individual time-control of each stage of a process, regulate the sequence and permit automatic repetition. These are some of the considerations now called to mind by Londex, Ltd., which has issued a series of leaflets describing its instruments and their varied applications in the chemical industry.

* * *

VALUABLE work is being done by the Scientific Film Association, whose wide range of activities are reflected in its quarterly "Bulletin", the June issue of which is now available. Among the wide range of films considered by the appraisal committee were a large number on chemistry. The association has organised conferences and exhibitions of scientific films and will send a delegation to the fourth congress of the International Scientific Film Association in Italy in October. The Scientific Film Association appeals for more members to support its work which is largely voluntary, and also requires more specialists for the panels which appraise the new specialist films.

* * *

A NEW step in the many varied industrial applications of aluminium and its alloys is marked by the production by the aluminium industry of additional extruded sections that will be of assistance to road vehicle designers and builders. A total of 32 sections is described in the latest addition (AB/5) to the series of application brochures available from the Aluminium Development Asssociation.

* * *

THE wide range of interests covered by the Powell Duffryn group is reflected in the variety of subjects featured in the July issue (No. 84) of the "Powell Duffryn Review." The entry of Powell Duffryn Carbon Products, Ltd., into the field of chemical carbons is noted by a description of the three principal products: chemical tiles for vat linings, the cubic heat exchanger and Paragrid tower packings, which were exhibited at the BIF, Birmingham.

* * *

CRITICISM that insufficient use is made of transparent film and sheet in the packaging of British goods is contained in the report on "Consumer Goods for the Canadian Market" made by the British Export Trade Research Organisation to the President of the Board of Trade, and now published by HMSO.

* * *

THE British Standards Institution has just issued the first revision of a British Standard relating to cod oil for sulphonation purposes (B.S. 868:1950). It was originally published in 1939 and, although some of the characteristics have been slightly amended, the principal reason for the revision was that the methods of test have been brought into line with current practice. The standard provides limits for various characteristics as well as full description of the test methods.

Copies of this standard cost 2s. (post paid).

[By courtesy of Girdlestone Pumps, Ltd.

An exceptional example of a pumping operation being carried out under arduous conditions is represented in this picture of a Girdlestone glandless diaphragm pump circulating vitreous enamel. Designed to circulated corrosive and abrasive materials, the pump will operate with a wide range of liquids, from hydrochloric acid to solutions containing diamond dust and ground glass. The liquid is completely sealed and all potential leak points (stuffing boxes, rotary seals, etc.) have been eliminated

THE CHEMICAL ELEMENTS AND THEIR COMPOUNDS. N. V. Sidgwick. 1950. London: Oxford University Press (Geoffrey Cumberlege). 2 Vols. Pp. xxxii + 853; vi + 850. 70s.

Professor Sidgwick's book has long been awaited by inorganic chemists, and its appearance may be said to provide a landmark in the development of textbooks in inorganic chemistry. A large amount of material has been gathered together here which cannot otherwise be readily obtained. Professor Sidgwick is, however, fully aware that it is not sufficient merely to collect facts without any serious attempt to put these in order. Indeed, one of the flaws in the teaching of inorganic chemistry in the past has been the failure to realise the most fundamental task of the chemist is not merely to collect facts, but to determine the theoretical relationships between them. Too many textbooks have alienated students from the inorganic field simply because they have given the impression that the study of inorganic chemistry demands the capacity to swallow masses of unco-ordinated and often apparently irreconcilable snippets of information.

The theory of the structure of matter has, however, been sufficiently advanced long enough to permit this illusion to be dispelled. Students should realise that it is possible to learn a great deal of inorganic chemistry with hardly a reference to specific compounds: while there are a number of excellent textbooks of a more specialised nature containing monographs on selected inorganic topics, which show clearly a profitable and a palatable approach to modern inorganic chemistry. Modern developments have done something to destroy the belief that inorganic chemistry is a finished chapter, and Professor Sidgwick's treatment of inorganic chemistry as a whole, rather than as a series of isolated topics, should help in furthering this view and in inducing the newer generation of chemists to regard the inorganic field as one worthy of research.

The claim for the book as a rational inorganic chemistry is quite justified. The chief regret is that the pattern on which discussion has been based is the short form of the Periodic Table rather than one of the long forms of the periodic classification of the elements. Adoption of one of the latter would have avoided the necessity of first classing together sub-groups of elements, and then demolishing the artificial links between these sub-groups which the short Periodic Table has constructed. The long forms, based on atomic structure, always impress the student as being more logical, particularly since here, in contrast, it is often possible to show that anomalous behaviour has a theoretical basis.

On the other hand, it is refreshing to find carbon treated in its inorganic context as, admittedly, the parent element of organic chemistry, but nevertheless amenable, in its compounds, to the same kind of theory as the remainder of the elements. Too often the distinction between carbon and other elements is emphasised by referring the reader to an organic textbook for even the most elementary treatment. Unification, by discussing carbon on its merits side by side with that of related elements, should be the aim of the teacher, bcause it is the proper fundamental approach, and also because contrast is as valuable as comparison.

The reader of these two volumes must be fully aware, as Professor Sidgwick readily admits in his introduction, that inorganic chemistry is advancing so rapidly that parts of the work had become incorrect or incomplete even at publication. No one, however, can fail to be impressed by the breadth of scholarship and the detailed labour that have gone to the making of the book. The author index alone occupies over 40 pages. It is not to be doubted that, as in the case of Professor Sidgwick's earlier books, this monumental work will prove an inspiration to the present generation of chemists, both inorganic and otherwise.

By comparison with contemporary scientific textbooks of comparable size and significance, the price is very reasonable. The publishers are to be congratulated for adjusting the cost of the book so as to place this wealth of information within the reach of any serious worker.—C.W.

OVERSEAS

Venezuelan Sugar

The Government of Venezuela proposes to spend 100 million bolivares on the development of sugar production during the next three years, in an effort to make the country self-supporting in this commodity.

New Canadian Aluminium Plant

A new pot line opened at Shawinigan Falls, Quebec, by the Aluminium Company of Canada to meet the continuing world demand for aluminium ingot, is expected to produce 15,000 tons of metal a year.

Industrial Explosives in French Guinea

The Sté. Générale d'Explosives is building a factory for the manufacture of industrial explosives at Kinakry in French Guinea, which it is hoped will help the mining industry as well as civil engineering.

New Australian Crystal Sulphate Plant

A new crystal sulphate plant installed by the Australian Iron & Steel Company at Port Kembla, New South Wales, is believed to be the first of its kind in the southern hemisphere. Ammonium sulphate fertiliser is being obtained as a by-product of coke oven operation. The crystal sulphate product is used by the Queensland sugar industry and for the manufacture of mixed fertilisers.

Lead Developments in Portugal

Portugal's production of lead concentrates is reported to have amounted to 1100 metric tons last year (1000 metric tons in 1948). Out of this total, the Mina de Ceife, near Penemacor, accounted for 800 metric tons with a lead-content of 60-65 per cent, and the Mina de Bracal, near Oporto, for 300 metric tons with a lead-content of 55-60 per cent. A project to double the capacity of the Mina de Ceife is being considered.

PVC Works for Japan

The Nissin Chemical Co. (formerly the Sumitomo Chemical Co.) is reported to be erecting a PVC works with an initial monthly capacity of 30 metric tons. It is hoped to increase the output within about two years, to 300 metric tons per month. The initial production will be used by the Sumitomo Electrical Industries Co. in the manufacture of electric cables. Except the polymerisation plant, all the machinery of the new works has been taken from the former rubber works of the Sumitomo Company in Niihama, Shikoku.

New U.S. Insulator

A high degree of resistance to flame and electrical properties approaching those of polythene is claimed for a new plastics electrical insulation material, Rulan, produced by the E. I. Du Pont de Nemours Company. It lends itself to high speed extruding on wire.

New German Oil Refinery

Work has recently started on the construction of a new German oil refinery near Holzhausen north of Lingen in the Emsland. The new plant, which is to start refining operations in 1952, will be one of the largest of its kind in Germany and will treat some 600,000 metric tons of crude annually. A pipe-line is to connect local oilfields with the plant.

French Uranium Mine Opened

A new uranium mine at La Crouzille, near Limoges, France, was put into service last week in the presence of M. Dautry, general administrator of the Atomic Energy Commission. The characteristic of the ore extracted at La Crouzille is that the pitchblende can be separated on the spot, whereas in other mines radioactive rock has to be crushed and washed beforehand.

Motor Spirit from Molasses

Proposals to utilise surplus molasses for the manufacture of anhydrous alcohol for use as motor spirit have been put forward by the Jamaica Sugar Manufacturers' Association for approval of the Government. It is estimated that in 1951 one million gallons of anhydrous alcohol could be produced. When mixed with petrol, it is claimed, this would keep in the island £50,000 spent on imported fuel.

New Hydrogen Peroxide Source

What was described as a feasible alternative method of producing hydrogen peroxide was outlined recently by chemists of the University of Washington (G. L. Putnam and J. F. Sullivan) to the American Chemical Society. It is designed to use the large volumes of hydrogen, by-product of the electrochemical industry, and oxygen from the air approximately in the proportions of 20 to 1. The basic principle is heat treatment of the gas mixture and passing through it a high-voltage alternating current (maximum 15,000 volts). About 15 kWh are required to produce 1 lb. of hydrogen peroxide. Reduction of energy may be possible if special glass equipment is employed.

PERSONAL

MR. S. A. BARKER, B.Sc., Ph.D., of Birmingham University, has been appointed Mackinnon Research Student of the Royal Society for two years from October 1, 1950. He will work on the enzymic synthesis of polysaccharides.

MR. ARTHUR MASON, F.T.I., retired textile consultant, living at Marlow, Bucks., has been elected an honorary life member of the Textile Institute. He served as a member of the Institute's Council in 1944-45, and of the London Section Committee from 1939-45.

A research studentship, awarded by the Textile Institute in 1948 to MR. F. R. ALSBERG, A.T.I., of Prestwich, near Manchester, and renewed in 1949, has been renewed for a further year to enable him to continue research work at Manchester College of Technology. Mr. Alsberg a laboratory assistant at I.C.I., Ltd., is making a quantitative examination of the effect of agitation on the rate of dyeing in the cellulose-direct dye system.

Among new fellows recently elected by the council of the Institution of Works Managers were the following:—MR. J. AYRES, director of the Brush Electrical Engineering Co., Ltd.; MR. H. L. SATCHELL, director, and MR. H. DREGHORN and MR. H. F. FARMER, superintendents, all of the company's Rugby works; MR. E. C. FRYER, general manager and director of Josiah Parkes & Co., Ltd.; MR. E. D. GALLOWAY, secretary of the Glasgow branch of Henry Wiggin & Co., Ltd.; MR. F. JENKS, manager of the oil production division of J. Bibby & Sons, Ltd., and MR. L. J. WALKER, works manager to Potter & Clarke, Ltd.

Fellows and Associates

THE Institute of Physics has elected seven new Fellows and 25 Associates in this country and overseas. They are these:—

Fellows. W. J. R. Calvert, K. R. Makinson (Australia), T. C. Marwick, J. B. Rudd, M. K. Sen (India), L. A. A. Thomas and H. W. Thompson.

Associates. W. H. Alexander, G. W. Bloomfield, L. Brown, J. Critchlow, A. W. Cronshaw, D. E. Davies, G. W. Eastwood, F. H. Hibberd (Australia), R. J. Hodgkinson, D. Jolly (Australia), C. E. Jones, R. Joseph, A. J. Kent, A. G.

(continued at foot of next column)

Loudon, K. W. Lyon, C. R. Major, J. M. Messenger (Kenya), A. C. Moore, D. A. Perrott, P. W. Roberts, W. A. D. Randall, A. G. Thompson, E. J. W. Whittaker, D. J. Williams and J. G. Walford.

In addition 22 graduates, three subscribers and 18 students were elected.

PHYSICS AND INDUSTRY

THE growth of the activities and importance of the Institute of Physics, associated with the increasing impact of physics in current industrial operations, is reflected in the summary of the institute's work during 1949.

The trend was made evident at the annual meeting of the organisation in London on July 20, at which Prof. W. E. Curtis, professor of physics at King's College, University of Durham, was elected president.

Prof. E. G. Cox was elected a vice-president, and Dr. F. P. Bowden and Mr. G. R. Noakes were elected ordinary members of the board. The hon. treasurer, Mr. E. R. Davies, and the hon. sec. Dr. B. P. Dudding were re-elected. Prof. H. W. Thompson joined the board as the new representative of the Faraday Society.

New Sections

The report for 1949 records the inauguration during the year of the Education Group and the North Eastern branch, making the seventh specialist subject group and the eighth branch. These 15 groups and branches held many meetings and visited various laboratories; the five divisions of the Australian branch held 39 meetings during the year.

An outstanding event was the first convention of its kind to be organised by the institute. This was held in Buxton and was attended by over 400 people.

Nine colleges in England and Wales have had their courses approved for national certificates in applied physics and arrangements were made with the Scottish Education Department for the establishment of similar courses in Scotland.

The institute collaborated with the Universities of Bristol and Cambridge and University College, London, in summer schools on special branches of physics.

The report records the establishment in April this year of the *British Journal of Applied Physics* and a monthly *Bulletin*.

The institute's officers have dealt with many inquiries about salaries, conditions of service, consulting fees, professional training and similar matters.

HOME

New Chemists and Druggists

One hundred and seventy-one men, and 72 women were successful in the July examinations of the Pharmaceutical Society.

Less Coal Raised

Mining output in the week ended July 22, diminished by holidays, was for the second week below the level of 4 million tons (deep mined). The yields were 3,881,600 tons and 257,400 tons from open-cast operations.

Freer Imports from Belgium

In accordance with the liberalisation of trade policy, Board of Trade open general licences have been extended to embrace Belgium, Luxemburg and the Belgian Congo from July 17. A large range of goods from these countries is now freed from import licensing restrictions.

I.C.I. Celebrations

Presentation of long service awards to 100 members of the Gaskell-Marsh works were made at the I.C.I. recreation club, Widnes, last week, by Mr. G. K. Hampshire, chairman of the General Chemicals Division. At the same time the chemical workers and staffs presented the board of directors with a memento of the Widnes centenary celebrations.

Textile Technology

A record number of 180 candidates sat for the annual examination of the Textile Institute in general textile technology. The pass list, issued last week, showed that 71 were successful, while some overseas results had yet to be announced. Last year there were 144 entrants of whom 64 passed. The only woman candidate this year was Miss J. M. Reading, aged 23, who was sucessful. She studied at Leicester College of Technology and is a laboratory assistant with a Leicester firm.

London HQ for Standard Oil

The Anglo-American Oil Co., Ltd., has announced that the Esso Export Corporation, international sales affiliate of Standard Oil Company (New Jersey), is to establish a European administrative office. The headquarters will be in London and the purpose to co-ordinate the refinery production of all Jersey Standard's affiliates in Western Europe and to adjust the balance of market requirements. Mr. George M. Parker, lately adviser to the Jersey organisation in foreign marketing operations, has been elected vice president and will be in charge of the European office.

"The Growth of Solvents Production"

A commentary on the expansion since the war of products of British Industrial Solvents, Ltd. (THE CHEMICAL AGE, 63, 117) indicated that one of these was "di-ethyl hexyl alcohol." The new alcohol form is in fact 2-ethyl hexyl alcohol.

U.K. Light Metal Statistics

Ministry of Supply statistics relating to U.K. production, imports and consumption of light metals in May include the following (in long tons): Virgin aluminium: production 2590, imports 21,836. Secondary aluminium: production 7204. Aluminium scrap arisings 8382; consumption 9769. Aluminium fabrication 18,334; foil 1003. Magnesium fabrication 287.

Leeds Gifts for Research

The Yorkshire Dyeware & Chemical Co., Ltd., has given £200 a year for the seven years, starting 1951-52, towards the payment of a research assistant in the Colour Chemistry and Dyeing Department of Leeds University. A gift of £400 has also been received from the Association of the Leather Trades of Leeds and District for the Leather Industries Department of the University.

Miners' Wage Claim

The National Union of Mineworkers, at an informal meeting with the National Coal Board in London on July 20, presented its claim for an increase in wages. The board and the union expressed their regret that their meeting should have taken place at a time when some pits in Scotland were still affected by an unofficial strike. It was decided that if the men on strike had returned on Tuesday this week, a meeting of the joint national negotiating committee for the coal mining industry would take place on that day.

Colliery Exploits Natural Gas

A scheme to fire all four boilers of Point of Ayr Colliery, Flintshire, with natural gas is nearing completion. It is stated that already 6500 tons of coal are being saved and several men have been released for the direct production of coal. Efforts were made to remove some of the gas in advance of the coal workings before 1940, either by compressing it into cylinders for driving vehicles or by burning it in the colliery boilers. Shortage of equipment held up the work, which was taken up again in 1947. On April 23 sufficient gas was coming up to fire one boiler, followed by a second on May 4.

Company News

The Distillers Co., Ltd.

The consolidated profits of the Distillers Company and its subsidiaries in the year ended March 31 totalled £12,837,691, which compares with £10,361,857 in 1948-49. After sundry credits and charges, including £953,078 to cover depreciation (£507,095 in the previous year) there remains £6,379,300 (£5,130,597). The recommended final dividend on the ordinary stock is 7.2d. per 4s. unit, making a total return equivalent to 20 per cent for the year. Employees are to receive an "export incentive bonus" of 2½ per cent of their wages or salaries.

Increases of Capital

The following increases in registered capital have been announced: Anchor Chemical Co., Ltd., from £150,000 to £225,000; Lodge-Cottrell, Ltd., from £100,000 to £300,000; Unifloc, Ltd., from £16,000 to £80,000.

New Registrations

Chemical Developments (Luton), Ltd.

Private company. (484,483). Capital £500. Chemical manufacturers and distributors, dye makers, dyers, bleachers, makers of acids, limes, alkalis and chemicals of all kinds. Solicitors: Giffen, Couch & Archer, Luton.

Nucleonic and Radiological Developments, Ltd.

Private company. (484,581). Capital £10,000. To develop and manufacture equipment and apparatus for electrical, radiological, nuclear and physical engineering. Reg. office: Baltic House, Leadenhall Street, E.C.

Japanese Production Plans

THE Japanese Ministry of International Trade and Industry indicates that a production plan for synthetic organic chemicals in the year ending March 31, 1951, calls for the following: (in metric tons) acetaldehyde, 17,100; acetic acid, 16,050; acetic anhydride, 2340; butanol, 2620; butyl acetate, 1800; cellulose acetate, 810; ethyl acetate, 3650; ethylene glycol, 500; formaldehyde (40 per cent), 7500; formic acid (80 per cent), 240; methanol, 20,000; oxalic acid, 960; trichloroethylene, 400; vinyl acetate, 6400; and vinyl chloride 2100.

ENGINEERING PAPERS

A USEFUL programme of meetings was held by the Chemical Engineering Group of the Society of Chemical Industry in 1948 and the activities have now been summarised in Volume 30 of *Proceedings*, with illustrations and diagrams (price 21s.). A number of papers presented during the year have been permanently recorded in this volume. They are as follows: "Abrasion, Erosion and Corrosion," C. H. Desch; "What Can We Learn from the Mechanical Engineer in Process Design?" E. J. Stephens; "Recent Developments in Brewery Plant and Equipment in Scandinavia and U.S.A.," J. L. McCowen; "A New Cast Iron: the Nodular Graphite Structure," J. G. Pearce; "Modern Propellants Used in British Ordnance," J. N. Pring; "The Refining and Hardening of Vegetable Oils," A. Arneil; "The Production of 96 per cent Sulphuric Acid on a Chamber Plant," S. B. Cormack; "Recent Developments in High Vacuum Technology," R. S. Morse; "Heat Transfer," A. D. Davidson; "Physiological Effects of the Products of Nuclear Fission," Katharine Williams; "Radiation Hazards and their Control," E. F. Edson.

Synthetic Fuels and Chemicals

IN view of the current shortages of benzene and phenol, the United States Bureau of Mines is undertaking a new investigation of the likely yield of these and other chemicals as a result of producing synthetic liquid fuels from coal and oil shale.

Benzene becomes continually more important as a basic raw material. Such products as synthetic rubber, plastics, nylon and detergents readily account for the sharp increase in demand during the past ten years. Until recently, benzene was available only as a co-product in the manufacture of oven coke. Now, for the first time, benzene is being produced from petroleum at Texas City, Texas, where a plant has been established with an annual capacity of 5 million gal.

Shale oil also contains significant amounts of aromatic chemicals, "tar acids"—phenol, cresols, and xylenols—and "tar bases"—homologues of pyridine and quinoline. Preliminary determinations of the volume of aromatics in crude shale oil indicate a larger percentage of "tar bases" than in tars from coal carbonisation.

Chemical and Allied Stocks and Shares

LATEST Korean war news and expectations that rearmament means increased taxation have kept markets subdued. Most sections were easier under the lead of British Funds. There was little selling, and buyers showed great caution awaiting developments. Armament and kindred shares were the only section to show gains.

Chemicals kept steady with Imperials little changed at 40s. 6d., but Monsanto eased to 48s. 6d., although British Glues and Chemicals 4s. ordinary were firm at 23s. 3d., on the big profit increase shown for the past year, the unchanged 25 per cent dividend and the share bonus of two new shares for every seven held.

Laporte Chemicals 5s. shares were 10s. 3d., while Albright & Wilsons 5s. shares kept at 29s. 3d., the market expecting the latter company to announce its new issue plans soon. Amber Chemical 2s. shares were 3s., F. W. Berk 10s. 3d., Boake Roberts 5s. shares 26s. 6d., while Brotherton 10s. shares were firm at 20s. and W. J. Bush 72s. Bowman Chemical 4s. shares were 5s. 3d. and Pest Control 5s. shares 7s. 4½. Sanitas Trust 10s. shares were 15s. 6d. L. B. Holliday 4½ per cent preference were 19s. 6d. and Woolley 4¾ per cent debentures 104½.

The 4s. units of the Distillers Co. were active around 18s. 7½d., on the big increase in group trading profits. Taxation limits earnings, but the decision to pay 20 per cent dividend on the larger capital is regarded as indicating confidence, and the market expects that this rate will be maintained in future. It represents an increased cash distribution for shareholders because it compares with 27½ per cent for the previous year which would have been equivalent to 18¾ per cent on the capital now ranking. This has, of course, been increased by the 50 per cent share bonus.

Borax Consolidated have been steady at 54s. 6d., so have British Aluminium at 39s. 6d., but Turner & Newall eased slightly to 81s. 3d., United Molasses to 42s. and Dunlop Rubber to 60s. 1¼d. Lever & Unilever were steady at 39s., prior to the annual meeting. Iron and steels were generally higher, having attracted attention together with other companies which can be expected to benefit from rearmament. Colvilles were 35s. 3d., United Steel 27s. 3d., Stewarts & Lloyds 55s. 9d., John Summers 29s. 7d., Guest Keen 45s. 9d., while elsewhere, Babcock & Wilcox were up to 63s. 3d., and T. W. Ward 63s.

Shares of plastic companies were generally steady but De La Rue eased to 22s. 9d., following the results, although the maintained dividend was good. British Industrial Plastics 2s. shares were 5s. 7½d., and British Xylonite 72s. 6d. Boots Drug were better at 47s., with British Drug Houses 5s. shares 7s. Triplex Glass kept steady at 21s. 9d. with United Glass Bottle firm at 75s. After rallying towards the end of last week, oils came back with the general trend. Shell were back to 62s. 6d. and Anglo-Iranian to £5 18/16 while Burmah Oil reacted sharply to 55s. 7½d.

Indian Castor Oil Specification

A UNIFORMLY good quality for castor oil is a matter of considerable importance to India, which produces some 38,000 tons annually, of which nearly 17,000 tons are exported. The lubricants sectional committee of the Indian Standards Institution has therefore developed a draft Indian standard specification for this oil.

The standard covers the requirements for four grades of castor oil in respect of clarity, colour, specific gravity, refractive index, saponification value, iodine value, acetyl value, acid value, unsaponifiable matter, critical solution temperature and ash content of the oil. Methods of sampling and testing of castor oil have also been included in the specification in two appendices.

This draft has been circulated to members of the institution and to large consumers, manufacturers and technologists concerned. Comments will be received by the director, Indian Standards Institution, Delhi, up to August 5, 1950.

More Petroleum for Germany

The economic authorities in the Federal German Republic are planning to terminate control and rationing of liquid fuels as from January 1, 1951. It is hoped to free Diesel oil this autumn. The proposals presuppose the availability of adequate domestic reserves, equivalent to at least the average quarterly consumption. The additional cost of supplying the German liquid fuel market after the termination of control is estimated at about Dm. 180 million annually. Crude oil output in Western Germany in May amounted to 93,778 metric tons, compared with 89,550 tons in April.

Prices of British Chemical Products

Rising Cost of Metal Derivatives

REASONABLY active trading conditions prevail generally on the industrial chemicals market. The volume of inquiry both for home and for shipment continues to be satisfactory, although uncertainty in the international situation is not without its effect on new contract business. While there has been little change in the overall price position, the undertone is strong in nearly all sections of the market. Trading conditions in the coal tar products market have been well maintained, with creosote oil and the light distillates again in good request.

MANCHESTER.—Values on the Manchester market for heavy chemical products during the past week have remained steady to firm in all sections, with further advances recorded in the lead compounds as a result of the fresh rise in the metal. On home trade account there has been a fairly regular movement of supplies of most of the leading chemicals against contract commitments. Replacement buying has occurred as the need arose, while a fair trade passed for shipment, mainly to the Empire markets. Some activity is reported in the fertiliser market, with a moderate volume of business being transacted in both the light and heavy tar products.

GLASGOW.—Business in general has been fairly good over the past week in the Scottish chemical market, although the Glasgow Fair holidays have somewhat diminished the bulk quantities required. The export market continues to be reasonably active.

Price Changes

Rises: Copper carbonate, copper sulphate, red lead, white lead, litharge, phosphoric acid, salicylic acid, sodium nitrate (Chilean), carbon tetrachloride, carbolic acid crystals (Manchester).

Reductions: Butyl acetate BSS, butyl alcohol BSS, magnesium chloride.

General Chemicals

Acetic Acid.—Per ton: 80% technical, 1 ton, £61; 80% pure, 1 ton, £66; commercial glacial 1 ton £71; delivered buyers' premises in returnable barrels; in glass carboys, £7; demijohns, £11 extra.

Acetic Anhydride.—Ton lots d/d, £110 per ton.

Acetone.—Small lots: 5 gal. drums, £90 per ton; 10 gal. drums, £85 per ton. In 40/45 gal. drums less than 1 ton, £70 per ton; 1 to 9 tons, £69 per ton; 10 to 50 tons, £68 per ton; 50 tons and over, £67 per ton.

Alcohol, Industrial Absolute.—50,000 gal. lots, d/d, 2s. 1d. per proof gallon; 5000 gal. lots, d/d, 2s. 2½d. per proof gal.

Alcohol, Diacetone.—Small lots: 5 gal. drums, £133 per ton; 10 gal. drums, £128 per ton. In 40/45 gal. drums: less than 1 ton, £113 per ton; 1 to 9 tons, £112 per ton; 10 to 50 tons, £111 per ton; 50 to 100 tons, £110 per ton; 100 tons and over, £109 per ton.

Alum.—Loose lump, £17 per ton, f.o.r. MANCHESTER: Ground, £17 10s.

Aluminium Sulphate.—Ex works, £11 10s. per ton d/d. MANCHESTER: £11 10s.

Ammonia, Anhydrous.—1s. 9d. to 2s. 3d. per lb.

Ammonium Bicarbonate.—2 cwt. non returnable drums; 1 ton lots £40 per ton.

Ammonium Carbonate.—1 ton lots: MANCHESTER: Powder, £52 d/d.

Ammonium Chloride. — Grey galvanising, £27 10s. per ton, in casks, ex wharf. Fine white 98%, £21 10s. to £22 10s. per ton. See also Salammoniac.

Ammonium Nitrate.—D/d, £18 to £20 per ton.

Ammonium Persulphate.—MANCHESTER: £5 per cwt. d/d.

Ammonium Phosphate.—Mono- and di-, ton lots, d/d, £78 and £76 10s. per ton.

Amyl Acetate.—In 10-ton lots, £171 10s. per ton.

Antimony Oxide.—£160 per ton.

Antimony Sulphide.—Golden, d/d in 5 cwt. lots, as to grade, etc., 1s. 9½d. to 2s. 4¾d. per lb. Crimson, 2s. 6½d. to 3s. 3½d. per lb.

Arsenic.—Per ton, £38 5s. to £41 5s., ex store.

Barium Carbonate.—Precip., d/d; 2-ton lots, £27 5s. per ton, bag packing, ex works.

Barium Chloride.—£35 to £35 10s. per ton

Barium Sulphate (Dry Blanc Fixe).—Precip., 4-ton lots, £29 10s. per ton d/d; 2-ton lots, £29 15s. per ton.

Bleaching Powder.—£25 15s. per ton in casks (1 ton lots).

Borax.—Per ton for ton lots, in free 140 lb. bags, carriage paid: Anhydrous, £54; in 1-cwt. bags, commercial, granular, £34 10s.; crystal, £37; powder, £38, extra fine powder, £39; B.P., granular, £44; crystal, £46; powder, £48-£48 10s.; extra fine powder £48.

Boric Acid.—Per ton for ton lots in free 1-cwt. bags, carriage paid: Commercial, granular, £62; crystal, £69; powder, £66 10s.; extra fine powder, £68 10s.; B.P., granular, £75 10s.; crystal, £81; powder, £78 10s.; extra fine powder, £80 10s.

Butyl Acetate BSS.—£144 10s. per ton, in 10-ton lots.

Butyl Alcohol BSS.—£135 10s. per ton, in 10-ton lots.

Calcium Bisulphide.—£6 10s. to £7 10s. per ton f.o.r. London.

Calcium Chloride.—70/72% solid £9 12s. 6d. per ton, in 4 ton lots.

Charcoal, Lump.—£25 per ton, ex wharf. Granulated, £30 per ton.

Chlorine, Liquid.—£28 10s. per ton d/d in 16/17-cwt. drums (3-drum lots).

Chrometan.—Crystals, 6d. per lb.

Chromic Acid.—1s. 10d. to 1s. 11d. per lb., less 2½%, d/d U.K.

Citric Acid.—Controlled prices per lb., d/d buyers' premises. For 5 cwt. or over, anhydrous, 1s. 6½d., other, 1s. 5d.; 1 to 5 cwt., anhydrous, 1s. 9d., other, 1s. 7d. Higher prices for smaller quantities.

Cobalt Oxide.—Black, delivered, 9s. 10d. per lb.

Copper Carbonate.—MANCHESTER: 1s. 9d. per lb.

Copper Chloride.—(53 per cent), d/d, 1s. 11½d. per lb.

Copper Oxide. — Black, powdered, about 1s. 4½d. per lb.

Copper Nitrate.—(53 per cent), d/d, 1s. 10d. per lb.

Copper Sulphate.—£52 15s. per ton f.o.b., less 2%, in 2-cwt. bags.

Cream of Tartar.—100%, per cwt., about £7 2s. per 10 cwt. lot, d/d.

Ethyl Acetate.—10 tons and upwards, d/d, £103 10s. per ton.

Formaldehyde.—£31 per ton in casks, according to quantity, d/d. MANCHESTER: £32.

Formic Acid.—85%, £66 to £67 10s. per ton, carriage paid.

Glycerin.—Chemically pure, double distilled 1260 s.g. 128s. per cwt. Refined pale straw industrial, 5s. per cwt. less than chemically pure.

Hexamine.—Technical grade for commercial purposes, about 1s. 4d. per lb.; free-running crystals are quoted at 2s. 1d. to 2s. 3d. per lb.; bulk carriage paid.

Hydrochloric Acid.—Spot, 7s. 6d. to 8s 9d. per carboy d/d, according to purity, strength and locality.

Hydrofluoric Acid.—59/60%, about 1s. to 1s. 2d. per lb.

Hydrogen Peroxide.—1s. 0½d. per lb. d/d, carboys extra and returnable.

Iodine.—Resublimed B.P., 18s. per lb. in cwt. lots.

Iron Sulphate.—F.o.r. works, £3 15s. to £4 per ton.

Lactic Acid.—Pale tech., £85 per ton; dark tech., £75 per ton ex works; barrels returnable.

Lead Acetate.—Nominal.

Lead Carbonate.—Nominal.

Lead Nitrate.—Nominal.

Lead, Red.—Basis prices per ton: Genuine dry red lead, £114 10s.; orange lead, £126 10s. Ground in oil: red, £137 5s.; orange, £149 5s.

Lead, White.—Basis prices: Dry English, in 8-cwt. casks, £124 per ton. Ground in oil, English, under 2 tons, £143 10s.

Lime Acetate.—Brown, ton lots, d/d, £18 to £20 per ton; grey, 80-82 per cent, ton lots, d/d, £22 to £25 per ton.

Litharge.—£114 10s. per ton.

Lithium Carbonate.—7s. 9d. per lb. net.

Magnesite.—Calcined, in bags, ex works, £27.

Magnesium Carbonate.—Light, commercial, d/d, £70 per ton.

Magnesium Chloride.—Solid (ex wharf), £15 per ton.

Magnesium Oxide.—Light, commercial, d/d, £160 per ton.

Magnesium Sulphate.—£12 to £14 per ton.

Mercuric Chloride.—Per lb., lump, 7s. 4d.; smaller quantities dearer

Mercurous Chloride.—8s. to 9s. per lb., according to quantity.

Mercury Sulphide, Red.—Per lb., from 10s. 3d. for ton lots and over to 10s. 7d. for lots of 7 to under 30 lb.

Methanol.—Pure synthetic, d/d, £28 to £38 per ton.

Methylated Spirit.—Industrial 66° O.P. 100 gals., 3s. 7½d. per gal.; pyridinised 64° O.P. 100 gal., 3s. 8½d. per gal.

Nickel Sulphate.—F.o.r. works, 3s. 4d. per lb. (Nominal.)

Nitric Acid.—£24 to £26 per ton, ex works.

Oxalic Acid.—About £133 per ton packed in free 5-cwt. casks.

Paraffin Wax.—From £58 10s. to £101 17s. 6d., according to grade for 1 ton lots.

Phosphoric Acid.—Technical (S.G. 1.500), ton lots, carriage paid, £63 10s. per ton; B.P. (S.G.1.750), ton lots, carriage paid, 1s. 1½d. per lb.

Phosphorus.—Red, 3s. per lb. d/d; yellow, 1s. 10d. per lb. d/d.

Potash, Caustic.—Solid, £65 10s. per ton for 1-ton lots; flake, £76 per ton for 1-ton lots. Liquid, d/d, nominal.

Potassium Bichromate. — Crystals and granular, 9⅝d. per lb.; ground, 10⅜d. per lb., for not less than 6 cwt.; 1-cwt. lots, ½d. per lb. extra.

Potassium Carbonate.—Calcined, 98/100%, £64 per ton for 1-ton lots, ex store; hydrated, £58 for 1-ton lots.

Potassium Chlorate.—Imported powder and crystals, nominal.

Potassium Chloride.—Industrial, 96 per cent, 6-ton lots, £16.10 per ton.

Potassium Iodide.—B.P., 11s. 1d. to 12s. per lb., according to quantity.

Potassium Nitrate.—Small granular crystals, 76s. per cwt. ex store, according to quantity.

Potassium Permanganate.—B.P., 1s. 7½d. per lb. for 1-cwt. lots; for 3 cwt. and upwards, 1s. 6d. per lb.; technical, £6 13s. to £7 13s. per cwt.; according to quantity d/d.

Potassium Prussiate.—Yellow, nominal.

Salammoniac.—Dog-tooth crystals, £72 10s per ton; medium, £67 10s. per ton; fine white crystals, £21 10s. to £22 10s. per ton, in casks.

Salicylic Acid.—MANCHESTER: 2s. to 3s. 4½d. per lb. d/d.

Soda Ash.—58% ex depôt or d/d, London station, £8 17s. 3d. to £10 14s. 6d. per ton.

Soda, Caustic. — Solid 76/77%; spot, £18 4s. per ton d/d.

Sodium Acetate.—£41-£55 per ton.

Sodium Bicarbonate.—Refined, spot, £11 per ton, in bags.

Sodium Bichromate.—Crystals, cake and powder, 8d. per lb.; anhydrous, 7½d. per lb., net, d/d U.K. in 7-8 cwt. casks.

Sodium Bisulphite. — Powder, 60/62%, £29 12s. 6d. per ton d/d in 2 ton lots for home trade.

Sodium Carbonate Monohydrate.—£25 per ton d/d in minimum ton lots in 2-cwt. free bags.

Sodium Chlorate.—£52 to £57 per ton.

Sodium Cyanide.—100 per cent basis, 8d. to 9d. per lb.

Sodium Fluoride.—D/d, £4 10s. per cwt.

Sodium Hyposulphite. — Pea crystals £23 2s. 6d. a ton; commercial, 1-ton lots, £21 12s. 6d. per ton carriage paid.

Sodium Iodide.—B.P., 16s. 9d. per lb, in cwt. lots.

Sodium Metaphosphate (Calgon).—Flaked, loose in metal drums, £101 10s. ton.

Sodium Metasilicate.—£19 to £19 5s. per ton, d/d U.K. in ton lots.

Sodium Nitrate.—Chilean Industrial, 97-98 per cent, 6-ton lots, d/d station, £23 per ton.

Sodium Nitrite.—£29 10s. per ton.

Sodium Percarbonate.—12½% available oxygen, £7 17s. 9d. per cwt. in 1-cwt. drums.

Sodium Phosphate.—Per ton d/d for ton lots: Di-sodium, crystalline, £32 10s., anhydrous, £65; tri-sodium, crystalline, £32 10s., anhydrous, £64.

Sodium Prussiate.—9d. to 9½d. per lb. ex store.

Sodium Silicate.—£6 to £11 per ton.

Sodium Silicofluoride.—Ex store, nominal.

Sodium Sulphate (Glauber Salt).—£8 per ton d/d.

Sodium Sulphate (Salt Cake).—Unground. £6 per ton d/d station in bulk. MANCHESTER: £6 10s. per ton d/d station.

Sodium Sulphide. — Solid, 60/62%, spot. £25 15s. per ton, d/d, in drums; broken, £27 5s. per ton, d/d, in casks.

Sodium Sulphite.—Anhydrous, £29 10s. per ton; pea crystals, £20 10s. per ton d/d station in kegs; commercial, £12 to £14 per ton d/d station in bags.

Sulphur.—Per ton for 4 tons or more, ground, £15 11s. 6d. to £17 16s. 6d. according to fineness.

Sulphuric Acid.—160° Tw., £6 16s. to £7 16s. per ton; 140° Tw., arsenic free £5 10s. per ton; 140° Tw., arsenious, £5 2s. 6d. per ton; Quotations naked at sellers' works.

Tartaric Acid.—Per cwt: 10 cwt. or more £8 5s.

Tin Oxide.—1-cwt. lots d/d £25 10s. (Nominal.)

Titanium Oxide.—Comm., ton lots, d/d, (56 lb. bags) £102 per ton.

Zinc Oxide.—Maximum price per ton for 2-ton lots, d/d; white seal, £121 10s.; green seal, £120 10s.; red seal, £119.

Zinc Sulphate.—Nominal.

Rubber Chemicals

Antimony Sulphide.—Golden, 4s. to 5s. per lb. Crimson, 2s. 7½d. to 3s. per lb.

Arsenic Sulphide.—Yellow, 1s. 9d. per lb.

Barytes.—Best white bleached, £11-£11 10s. per ton.

Cadmium Sulphide.—6s. to 6s. 6d. per lb.

Carbon Bisulphide.—£37 to £41 per ton, according to quality, in free returnable drums.

Carbon Black.—6d. to 8d. per lb., according to packing.

Carbon Tetrachloride.—£59 10s. per ton.

Chromium Oxide.—Green, 2s. per lb.

India-rubber Substitutes.—White, 10 5/16d. to 1s. 5½d. per lb.; dark, 10½d. to 1s. per lb.

Lithopone.—30%, £36 15s. per ton.

Mineral Black.—£7 10s. to £10 per ton.

Mineral Rubber, "Rupron."—£20 per ton.

Sulphur Chloride.—7d. per lb.

Vegetable Lamp Black.—£49 per ton.

Vermillion.—Pale or deep, 15s. 6d. per lb. for 7-lb. lots.

Nitrogen Fertilisers

Ammonium Sulphate.—Per ton in 6-ton lots, d/d farmer's nearest station, £10 12s. (July, £12 6s. 6d.)

Compound Fertilisers.—Per ton d/d farmer's nearest station, I.C.I. No. 1 grade, where available, £10 17s. I.C.I. Special No. 1, £16 11s. (July, £19 4s.). National No. 2, £11 0s. 6d. per ton.

"Nitro-Chalk."—£10 4s. per ton in 6-ton lots, d/d farmer's nearest station.

Sodium Nitrate.—Chilean for 6-ton lots d/d nearest station, £19 17s. 6d. per ton.

Coal-Tar Products

Benzol.—Per gal, ex works: 90's, 3s. 3d.; pure, 3s. 5½d.; nitration grade, 3s. 7½d.

Carbolic Acid.—Crystals, 10½d. to 1s. 0½d. per lb. Crude, 60's, 4s. 3d. MANCHESTER: Crystals, 11½d. to 1s. 1½d. per lb., d/d crude, 4s. 3d., naked, at works.

Creosote.—Home trade, 6½d. to 9½d. per gal., according to quality, f.o.r. maker's works. MANCHESTER: 6½d. to 9½d. per gal.

Cresylic Acid.—Pale 98%, 3s. 3d. per gal.; 99.5/100%, 3s. 11d. American, duty free, 4s. 2d., naked at works. MANCHESTER: Pale, 99/100%, 3s. 11d. per gal.

Naphtha.—Solvent, 90/160°, 2s. 10d. per gal. for 1000-gal. lots; heavy, 90/190°, 2s. 4d. per gal. for 1000-gal. lots, d/d. Drums extra; higher prices for smaller lots. Controlled prices.

Naphthalene.—Crude, ton lots, in sellers' bags, £9 1s. to £12 13s. per ton according to m.p.; hot-pressed, £14 15s. to £15 14s. per ton, in bulk ex works; purified crystals, £28 to £43 5s. per ton. Controlled prices.

Pitch.—Medium, soft, home trade, 90s. per ton f.o.r. suppliers' works; export trade, 110s. per ton f.o.b. suppliers' port. MANCHESTER: £5 10s. f.o.r.

Pyridine.—90/160°, 22s. 6d. MANCHESTER: 20s. to 22s. 6d. per gal.

Toluol.—Pure, 3s. 2½d. per gal. MANCHESTER: Pure, 3s. 2d. per gal. naked.

Xylol.—For 1000-gal. lots, 4s. 0½d. to 4s. 3d. per gal., according to grade, d/d.

Wood Distillation Products

Calcium Acetate.—Brown, £15 per ton; grey, £22.

Methyl Acetone.—40/50%, £56 to £60 per ton.

Wood Creosote.—Unrefined, from 3s. 6d. per gal., according to boiling range.

Wood Naphtha.—Miscible, 4s. 6d. to 5s. 6d. per gal.; solvent, 5s. 6d. to 6s. 6d. per gal.

Wood Tar.—£6 to £10 per ton.

Intermediates and Dyes (Prices Nominal)

m-**Cresol** 98/100%.—Nominal.

o-**Cresol** 30/31° C.—Nominal.

p-**Cresol** 34/35° C.—Nominal.

Dichloraniline.—2s. 8½d. per lb.

Dinitrobenzene.—8½d. per lb.

Dinitrotoluene.—48/50° C., 9½d. per lb.; 66/68° C., 1s.

p-**Nitraniline.**—2s. 11d. per lb.

Nitrobenzene.—Spot, 5½d. per lb. in 90-gal. drums, drums extra, 1-ton lots d/d buyers' works.

Nitronaphthalene.—1s. 2d. per lb.; P.G. 1s. 0½d. per lb.

o-**Toluidine.**—1s. per lb., in 8/10-cwt. drums, drums extra.

p-**Toluidine.**—2s. 2d. per lb., in casks.

m-**Xylidine Acetate.**—4s. 5d. per lb., 100%.

Latest Oil Prices

LONDON: July 26. The prices of all refined oil and fats remain unchanged during the eight-week period ending on August 12. Prices of all unrefined oils and fats remain unchanged during the four-week period ending August 5.

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CARTON FILLING, PACKING, WRAPPING AND LABELLING MACHINE by **SOCIETE INDUSTRIELLE SUISSE,** adjustable for cartons from 73 mm. sq. by 38 mm. to 65.6 mm. sq. by 38 mm. Motorised 400/3/50. Complete with label attachments and heat sealing device. Conveyor feed approx. 55 per min.

TROUGH MIXER/DRYER by **SIMON,** horiz., int. dimens., 8 ft. by 2 ft. 6 in. deep by 2 ft. 8 in. wide. Agitator comprises bank of 16 solid drawn tubes, approx. 6 ft. 6 in. long by 2¾ in. o.d. Chain and sprocket drive, 8 in. square bottom side discharge.

Two **EVAPORATING AND DISTILLING PLANTS** by **G. & J. WEIR,** new 1945. Capacity 100 tons each, fresh water in 24 hours. Evaporators, 6 ft. 9 in. high by 30 in. diam. 10 banks copper steam coils secured in C.I. header easily removed by opening inspection doors (spare coils available). Each unit complete with distiller condenser, 2 ft. diam. by 4 ft. 10 in. Cooler condenser, 9 in. diam. by 4 ft. 10 in. One evaporating reciprocating steam driven combination pump dealing with feed discharge and vacuum, and one steam driven reciprocating circulating water pump. Interconnecting piping not included.

Complete **DISTILLED WATER PLANT** comprising six steam heated Manesty stills, type No. 4, 50 gallons per hour each. One automatic loading tank. Two direct motor driven rotary pumps. Vert. pressure storage tank of welded construction, suitable lagged, approx. 11 ft. deep by 5 ft. 6 in. diam., with raised manhole 2 ft. diam. with eighteen 1 in. diam. swing bolts for securing. Unit complete with all connecting piping, valves, etc.

Six **JACKETED MIXERS** by **BAKER PERKINS,** trough, 31 in. by 28½ in. by 28 in., twin Naben type blade agitators. Hand op. tilting. Trough fitted aluminium cover. Direct drive by T/E geared B.T.H. motor, 400/440/3/50.

Three double trough type **JACKETED MIXERS** by **WERNER PFLEIDERER,** trough 24½ in. by 24½ in. by 19½ in. deep, fitted double fin type agitators. Driven at variable speeds through single machine cut gearing from clutch op. driving and reversing pulleys. Hand op. tilting. Agitators can be used whilst tilting. 10/15 h.p. required to drive.

Eight double trough type **JACKETED MIXERS** by **WERNER PFLEIDERER.** Int. dimens., 2 ft. 4½ in. by 2 ft. 5 in. by 2 ft. 3½ in. deep. Fitted twin double fin type agitators, driven through gearing by pulleys. Hand op. tilting. 10/15 h.p. required to drive.

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PORTABLE BELT CONVEYOR, 25 ft. centres; 10 ft. adjustable discharge height; 16 in. wide cleated belt; B.B. troughing and return idlers; 2 h.p. motor; trailing cable; metal decking. Condition equal to new.

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VARIOUS MIXERS FOR SALE

BAND CONVEYOR, 50 ft. long 40 in. wide, steel frame, motorised, for boxes, cases, bags, etc.

A FILTER PRESS, 31½ in. square, fitted with 42 C.I. plates, centre fed.

FILTER PRESS, 25 in. square, fitted with 24 plates, cast iron built and steam heated.

Four **GARDNER HORIZONTAL MIXERS,** for powders, from 100 lbs. to 250 lbs. capacity, all motorised, three with Radicon Reduction Gear Boxes and one with a Spur Gear Drive.

Two large unjacketed **WERNER MIXERS,** belt and gear driven, hand tipping, double "Z" arms, pans 53 in. by 45 in. by 36 in. deep.

No. 200 One nearly new **WERNER PFLEIDERER JACKETED MIXER OR INCORPORATOR.** Low type, with C.I. built mixing chamber, 28 in. by 29 in. by 27 in. deep, with double "U"-shaped bottom which is jacketed, and double fish-tail or fin-type agitators geared together at one side, with belt-driven friction pulleys, 34 in. diam. by 5 in. face, with hand-wheel operation and hand-operated screw tilting gear. Machine fitted with machine-cut gears, covers, gear guard, cast-iron baseplate, and measuring overall approximately 7 ft. by 6 ft. by 4 ft. high to the top of the tipping screw.

No. 204 One **WERNER PFLEIDERER MIXER OR INCORPORATOR,** similar to the above, with a C.I. built pan 25 in. by 25 in. by 19 in. deep, belt pulleys 26 in. diam. by 5 in. face, double fin-type agitators, and mounted on C.I. legs.

No. 208 One **DITTO** by **WERNER PFLEIDERER,** with a C.I. built pan or mixing chamber, of the double "U" type, 4 ft. 5 in. long by 3 ft. 8 in. by 33 in. deep, with double "Z" mixing arms, gears at each end, hand-operated tilting gear, with steel backframe, counterbalancing weights and chains, and fast and loose pulleys 3 ft. diam. by 6 in. face.

No. 209 One **HORIZONTAL "U"-SHAPED MIXER,** steel built, riveted, measuring about 8 ft. 3 in. long by 3 ft. wide by 3 ft. 3 in. deep, with horizontal shaft, fitted with bolted-on mixing arms about 18 in. long by 4 in. wide, with intermediate breakers, and driven at one end by a pair of spur gears, with countershaft, fast and loose belt pulleys, outer bearing and plug cock type outlet at the opposite end, mounted on two cradles fitted to two R.S.J. running from end to end.

No. 210 One **HORIZONTAL MIXER** as above.

No. 211 One **HORIZONTAL MIXER** as above.

These three "U"-shaped mixers are in some cases fitted with steel plate covers and a steam jacket round the bottom and extending to within about 18 in. of the top with plain end plates.

Further details and prices upon application.

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JAC. VACUUM or DRYING OVENS, 8 ft. by 5 ft., 7 ft. by 4 ft. and 7 ft. by 3 ft. diam. (unused).
CONDENSERS by "Weir," 160 and 100 sq. ft., also six brass **SHELL CONDENSERS,** 3½ ft. by 5 in. diam., 325 – ⅝ in. copper tubes.
Twin "Z" blade **MIXERS,** ½-10 cwts. capacity.
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SEVERAL New Lacy-Hulbert **"BOREAS"** Dry **VACUUM PUMPS,** 45 c.f.m.
Several New Lacy-Hulbert **"BOREAS"** Dry **VACUUM PUMPS,** 10 c.f.m.
VERTICAL COPPER STILL, 28 in. diam. by 20 in. deep, with copper condenser.
190-gallon Mild Steel **REACTION VESSEL,** 4 ft. 6 in. diam. by 3 ft. 3 in. deep, dished bottom 1 ft. 3 in., fitted with external steam coils; Anchor-type stirrer.

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